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# PUBLIC HEALTH REPORTS

*In this issue*




U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service

# Waveform Analysis

## Function Generator-Fourier Analyzer

see overleaf

*Volume 69 Number 7* **July 1954**

# PUBLIC HEALTH REPORTS

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## *Contents*



**Continued ▶**

# Biological Waveform Analysis

A new experimental device, the "function generator-fourier analyzer," provides analysis of complicated waveforms, such as electrocardiograms, electrokymograms, and blood pressure recordings, in minutes instead of days. The analyzer uses electronic methods to analyze biological waves important in diagnosis and research.

In developing the apparatus, two scientists with the National Heart Institute, National Institutes of Health, Public Health Service, combined modern electronics with a mathematical concept originated by Baron Jean Baptiste Joseph Fourier, a 19th century French geometrician and physicist. Fourier developed a method of expressing complicated curves in terms of simple component sine functions. This method combined with electronics allows analysis of the frequency, amplitude, and phase relationships of the harmonic components which make up biological recordings.

A photoelectric feedback system forces a cathode ray beam to follow the edge of the waveform. The signal generated in this process is the electrical equivalent of the waveform. This signal is connected to a wave analyzer, which breaks down the signal to its component parts. This analysis is presented on a second cathode ray tube. The analysis is a precise physical description of the original waveform.

The analyzer may eventually be a timesaving aid to physicians in the precise classification of various readings taken on patients with heart and blood vessel diseases. Its most immediate application, however, is in providing help in improving instruments now being used for recording waveforms.

One possible inadequacy of a number of biological wave recording instruments is that they may not fully cover the frequency spectrum of the waveform and consequently will not give a truly accurate recording. On the other hand, the instrument may have a range greater than necessary for the particular waveform it is recording, and therefore be more complex and expensive than necessary. The analyzer will obtain information to indicate just how elaborate an instrument is needed to produce an ideal recording of a particular type of waveform.

## frontispiece...

The pattern on the slide is a test wave of a known formula used to determine the accuracy of the analyzer. The test pattern is processed in the analyzer and the results are compared with the known formula.

## *Contents for July, continued*

# PUBLIC HEALTH REPORTS




U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OVETA CULP HOBBY, *Secretary*

PUBLIC HEALTH SERVICE
LEONARD A. SCHEELE, *Surgeon General*

# Florida's Mosquito Control System

By JOHN A. MULRENNAN, B.S.A., and WILSON T. SOWDER, M.D., M.P.H.

SUBTROPICAL FLORIDA, with its 1,221 miles of coastline, heavy rainfall, warm climate, and flat topography, gives rise to an abundant and unique fauna. Included in this unusual fauna are a number of arthropods which are greatly annoying and which carry diseases of humans.

The extensive beaches of the State are sometimes laden with seaweed, the larval habitat for dogflies, or stableflies (*Stomoxys calcitrans*). The adjoining flat land mass is pocked with tremendous salt marshes, swales, swamps, fresh water marshes, ponds, lakes, or streams which afford an environment conducive to the heavy production of 67 species and subspecies of mosquitoes, 22 species of sandflies (*Culicoides* spp.), several species of yellowflies (*Chrysops* spp.), as well as many other species of arthropods annoying or dangerous to man.

### Early Observations on Mosquitoes

One of Florida's first counties, now Orange County, was once named Mosquito County. There was also a Mosquito Lagoon and a Mosquito Creek. The 1951 legislature abolished the name of Mosquito Lagoon, located in Volusia County.

The early settlements of Florida were almost entirely within the area later defined as the "malaria belt." Tallahassee, the State capital, was in the midst of this region. The Count of Castlenau, in his Views and Recollections of North America, describes the conditions which prevailed in the city in 1842: "But unfortunately in opposition to these numerous advantages there are the greatest plagues that can afflict a new settlement; an unhealthful climate; every year bilious fevers of a most dangerous nature spread consternation in the whole region. Then all the shops are closed, the fear of the epidemic and the stifling heat cause the planters of the neighborhood to leave the city, and all the inhabitants who can afford the expense of this kind go to the northern part of the United States to seek a more salubrious climate; the merchants take advantage of this season to go to New York or Philadelphia to place their orders, and the planter goes to Niagara or Saratoga Springs to display his luxury and spend in 3 months his year's revenue.

"However, although the climate is dangerous for strangers at all times, the most insalubrious months are August, September, October, and November; then no one can be sure of escaping the plague, neither the planter who has been settled in the country for years, nor the Negro born in the midst of the miasma of Carolina or under the burning sun of Georgia. The comparative extent of the huge cemeteries is a sad

*Mr. Mulrennan, director of the bureau of entomology of the Florida State Board of Health, has served as entomologist and malariologist in Florida and Texas since 1932. Dr. Sowder, Florida's State health officer since 1945, has directed various State and local venereal disease control programs. He has also served as consultant for the Federal War Shipping Administration and for the former Public Health Service district 9, Dallas, Tex.*

warning for one who, charmed by the beauty of the sight, would want to establish himself in this region."

This "insalubrious situation" prevailed in Florida for more than three centuries, but in 1948 the last definite case of malaria transmission was reported, and the last case of yellow fever was reported in 1905. The reported cases and deaths from malaria for the period 1918–53 show that malaria had practically disappeared in 1942 (fig. 1). The peaks in 1944 and 1946 were attributable to returning war veterans.

### Inception of Malaria and Mosquito Control

The direction of approach to the control of malaria was recognized in Florida as early as 1900 by Dr. J. Y. Porter, Florida's first State health officer, when he stated, "It was observed that the attacks [of malaria] were more than usually fatal along the river bottoms, marsh lands, and in the flat woods country. . . . It now is seen that it is not the germ itself which rises from the soil or water, but the *carrier of the germ*." Dr. Porter was also a courageous investigator of the means of contracting yellow fever. He once slept three nights in the bed of a man who had died of this disease in order to disprove the theory that fomites were responsible for its spread and to discourage the burning of bedding, the practice at the time.

Despite the early recognition of the cause of malaria, no organized effort was made to control it until the World War I period. At that time, drainage and larvicidal measures were introduced at Camp Johnston, near Jacksonville, jointly by the Army, the United States Public Health Service, and the Florida State Board of Health as a part of the general sanitation program around military establishments.

After this initial start, the Florida State Board of Health undertook its first malaria control project in 1919 in the city of Perry, a typical malarious community in Florida. At that time it was one of the largest projects of the kind in the country and involved the removal of 47,000 cubic yards of earth for drainage canals and ditches at an expenditure of $28,000. The cost of the project was borne by Perry, Taylor County, and the Burton Swartz Cypress Company. The State board of health supplied the technical supervision. A letter from the lumbering plant, after the work was completed, stated that the plant had been more than repaid for its share of the cost by the increased output resulting from the better health of plant employees.

### First Organized Control Effort

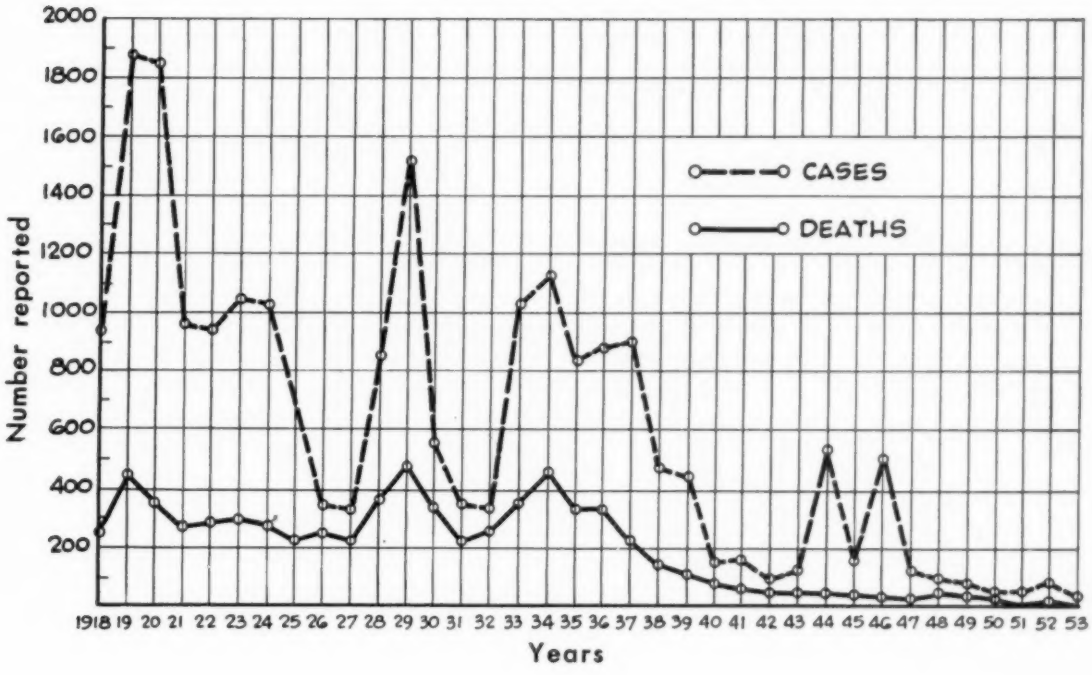
A great forward step in the control of mosquitoes in the State was the organization of the Florida Anti-Mosquito Association in 1922. The first meeting was called by Dr. J. Y. Porter, who, although no longer State health officer, retained a deep interest in the work. This organization has been primarily responsible for the promotion of legislation for the creation of mosquito control districts and of legislation making State aid possible to mosquito control districts and counties.

Another milestone was reached in 1931 when the Rockefeller Foundation established a malaria research station at Tallahassee to work with the State (mental) hospital at Chattahoochee and the State board of health. This station, under the direction of Dr. Mark F. Boyd from 1931 until its closing in 1947, performed work in the malaria field of inestimable value, not only to the State of Florida, but also to the world as a whole.

The State received further recognition in the mosquito research field when the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, established in 1932 a mosquito research station at Orlando. The station, in new quarters recently dedicated, is still functioning with funds made available by the Armed Forces. The research work of this station has been of great value to the mosquito workers of the State.

The year 1933 marked the beginning of widespread malaria and pest mosquito control operations throughout the State. The work was performed by the Federal relief organizations, the Civil Works Administration, the Emergency Relief Administration, and the Works Projects Administration, until 1941 when relief funds were withdrawn. A tremendous amount of drainage work was accomplished. The records show that more than 1,582 miles of ditches

Figure 1. Reported malaria cases and deaths in Florida, 1918–53.




were dug, with the removal of 225,287 cubic yards of earth. In 1935 the Public Health Service assigned engineers to the State to supervise the work.

In 1937 the Rockefeller Foundation, in cooperation with the Florida State Board of Health, the city of Pensacola, and Escambia County, organized a demonstration project for the filling of mosquito breeding areas and the lining of ditches with concrete "Panama inverts" and "Pensacola inverts."

In 1941 a bureau of malaria control was created within the Florida State Board of Health to study and make recommendations for controlling malaria in the State. The bureau was given the distinct recognition, during World War II, of being called upon by the Surgeon General's Offices of the Army and the Navy to set up a training station to teach the procedures of malaria control. Each class contained about 15 officers who were sent to foreign theaters of operation after 3 weeks' indoctrination in malaria control procedures. In all, about 200 officers were trained during an 18-month period. At the end of this period the Navy and the Army set up their own training schools at Bethesda, Md., and in the Panama Canal Zone.

In 1942 the Public Health Service set up the first Malaria Control In War Areas project at Tallahassee. Based on this first program, projects were set up at all military bases in the State, and similar projects were established in all the other southern States.

A program of DDT residual house spraying to eradicate malaria was inaugurated in 1945 in counties which had a high malaria rate in the past. All funds were supplied by the Public Health Service. Local funds were provided during the last part of the program, which was terminated in 1949. In addition to the house spraying program, a DDT dusting program was conducted in all counties having a high typhus rate.

In 1946 Florida's bureau of malaria control was abolished and a division of entomology was set up in the bureau of sanitary engineering. The division was responsible for promoting and carrying out all arthropod control work and for the administration of all arthropod control funds, as well as the enforcement of the Structural Pest Control Act. In 1953 the division of entomology was raised to independent bureau status.

### Mosquito Control Legislation

The first State law on mosquito control was passed in 1925, making it possible for a county to vote for a mosquito control district and for the residents to tax themselves for the work. Another State law was enacted in 1929, and in 1941 the legislature provided for three alternate methods for establishing mosquito control districts in the State.

These methods are similar in many respects, but differ in the composition of the boards, taxation, bonds, and political subdivisions covered by the laws. By one method residents can establish by vote any part of a county or the whole county as a mosquito control district. Three board members are elected at the same time. The law provides for an assessment up to 10 mills on all taxable property and the board may also issue bonds. Another method provides for five board members, an assessment of 1½ mills, and permits inclusion of one or more counties in a district. Under the third method either the board of county commissioners may act as mosquito control commissioners, or a separate five-member board may be elected. This method provides for a countywide district and limits the amount of taxation to a minimum of $10,000 and a maximum of $25,000 in counties with a population of less than 65,000; and a minimum of $20,000 and maximum of $50,000 in counties having 65,000 population or more.

The first State law providing for State aid to counties and mosquito control districts was passed in 1949. This law provided that aid be given by the State board of health to mosquito control districts and county health departments in the form of insecticides, materials, equipment, personnel, and trucks in amounts not to exceed $15,000 annually to any one county. This law for the first time recognized pest mosquitoes and other non-disease-bearing arthropods as being of public health and economic importance. A total of $350,000 has since been made available each year under this law by the State legislature for the control of mosquitoes and human-biting flies.

In 1953 upon the recommendation of the Florida State Board of Health, the State legislature passed a second State aid law whereby any board of county commissioners or a mosquito control district that places funds in its budget for the control of "arthropods of public health importance," would receive funds directly from the State, upon proper certification by the State board of health, amounting to 75 percent of the total funds appropriated by the county or district. This law stipulates that State funds are to be used exclusively for permanent eliminative measures such as sanitary landfills, filling and draining of breeding areas, the purchase of all types of equipment, the hiring of personnel, and the operation of equipment to be used in carrying out permanent measures of arthropod control. The legislature appropriated $1,250,000 annually for this program in addition to the annual appropriation of $350,000 for both permanent and temporary control measures. In addition to the direct aid to counties and mosquito control districts, this law provided an additional appropriation of $250,000 a year to be used by the State board of health for administration, consultation, and for

**Total expenditures by source of funds, at 5-year intervals, 1930–54, mosquito and other arthropod control in Florida**

| Source of funds | Fiscal year | | | | | |
|---|---|---|---|---|---|---|
| | 1930 | 1935 | 1940 | 1945 | 1950 | 1954 (estimated) |
| Total | [1] $16,726 | $9,492 | $75,892 | $512,342 | $979,071 | $3,322,105 |
| Federal (grant-in-aid and direct) | ---------- | ---------- | 20,492 | 404,756 | 83,942 | 8,000 |
| State | ---------- | ---------- | 4,730 | 5,022 | 93,321 | 1,850,000 |
| Local (county, city, and mosquito district) | ([2]) | ([2]) | 29,167 | 82,984 | 789,011 | 1,464,105 |
| Private (Rockefeller Foundation) | 16,726 | 9,492 | 21,503 | 19,580 | 12,797 | ---------- |

[1] Year 1931. [2] Figures not available.

the construction and operation of a research laboratory. The State of Florida is therefore at present appropriating a total of $1,850,000 annually for the control of mosquitoes and other arthropods of public health importance. Local appropriations for 1953–54 amounted to $1,464,-105, and direct Federal funds through the Public Health Service amounted to $8,000, making a total of $3,322,105 available for this purpose during the past fiscal year (see table).

The tourist industry is the largest industry in Florida and in 1953 brought in $950,000,000. It is therefore important that the State do all in its power to protect the health as well as the comfort of its visitors. Furthermore, the permanent residents of the State are not unappreciative of the benefits to themselves of a vigorous program against mosquitoes and other pestiferous arthropods.

The Florida State Board of Health is now planning to construct a biological research center in Indian River County on the southeast coast of Florida. It is expected that around $175,000 will be utilized in constructing and equipping the laboratory. In subsequent years it is planned to utilize about $150,000 a year for research, and approximately $100,000 is to be used in administering the mosquito control laws and in giving technical assistance to the counties.

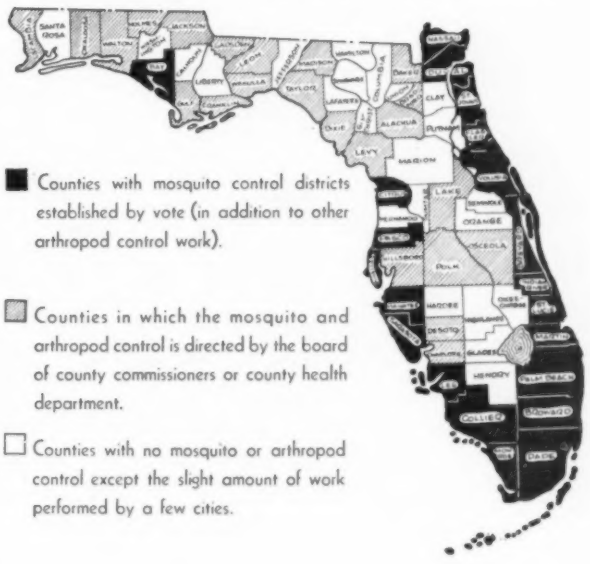
The purpose of the research center will be twofold: (*a*) to produce the biological information the State board of health needs to promote and carry out the most effective and efficient control program possible, and (*b*) to expedite the incorporation of this information into control practices. The research center will be intimately connected with the control operations in all districts and counties, and thus practical needs will direct its research efforts.

### Mosquito Control Districts

The first mosquito control district was established by vote in Indian River County in 1925. At the end of 1953 there were 23 mosquito control districts in 21 of Florida's 67 counties (fig. 2). In addition to the 21 counties having organized mosquito control districts, arthropod control is carried on by 23 additional counties and the work is administered by the boards of county commissioners and directed by the county health departments.

One small county, Brevard, with a population of 25,570 in 1950, appropriated $208,649 for mosquito control for the fiscal year 1953–54. Indian River County, a small county, has a per capita tax for mosquito control of $9.11 and Dade County (Miami), the wealthiest and most populous, has the lowest per capita tax of 17 cents.

**Figure 2. Florida districts and counties performing arthropod control, January 1, 1954.**




All mosquito and arthropod control is directed at the local level by an individual under the supervision of the mosquito control board or the board of county commissioners, elected by the people.

All boards are required by law to submit a plan of operation to the State board of health annually before expending their own funds or before receiving aid from the State. In order to assist the local boards with their administrative and technical problems, the State is divided into four operational districts. Stationed in each district are an engineer and an entomologist who are responsible for the arthropod control in an assigned number of counties.

Each board is also required by law to report each month on all county and State expendi-

tures for mosquito control as well as reporting at the end of each quarter on all of their operational activities.


### Summary

Florida's geographic location and flat topography afford a favorable environment for the production of 67 species of mosquitoes, 22 species of sandflies (*Culicoides* spp.), many species of yellowflies (*Chrysops* spp.), and one species of dogfly or stablefly (*Stomoxys calcitrans*). Since some of these species transmit human diseases and many of the species bite and annoy man, these arthropods have been a scourge as well as an economic liability to the State. The State laws provide three methods whereby the citizens may vote for a local mosquito control district and provide tax funds to carry out a control program. There are 23 mosquito control districts in the State and 23 counties that carry on mosquito control under the supervision of the county health departments. The districts and counties are now appropriating $1,464,105 for mosquito control. There are two State aid laws administered by the Florida State Board of Health. One law carries an annual appropriation of $350,000. The other law provides an appropriation of $1,250,000 for aid to districts and counties, and an appropriation of $250,000 to the State board of health for administration, technical assistance to local control bodies, and for research. At present, Florida is spending a total of $3,322,105 annually, under the supervision of the State board of health, to control mosquitoes and other arthropods of public health importance.


## Radiological Health Training Courses

Five training courses in radiological health will be presented at the Robert A. Taft Sanitary Engineering Center of the Public Health Service during 1954–55. The purpose of these courses is to indoctrinate public health workers with the significance of ionizing radiations, the environmental and occupational hazards attendant on their use, and recommended procedures for minimizing such hazards.

The courses are designed primarily for professional personnel of State and local health departments, but a limited number of qualified applicants from other government agencies and industry will be welcome.

Courses will be presented as follows:

November 1–5: Problems of radioactivity in water works.
January 10–21: Basic course in radiological health.
January 24–February 4: Occupational radiation protection.
March 7–10: Radiation hygiene, preventive medical aspects.
April 18–29: Basic course in radiological health.
May 2–13: Environmental radiation sanitation course.
May 16–20: Problems of radioactivity in water works.

For further information write to: Chief, Radiological Health Training Section, Robert A. Taft Sanitary Engineering Center, Public Health Service, 4676 Columbia Parkway, Cincinnati 26, Ohio.

# Mental Health Clinic Statistics

**needs**
**sources**
**methods**

*Lack of uniformity in statistical methods in mental hospitals and clinics was termed an important obstacle to adequate evaluation of procedures and therapies by the National Governors' Conference on Mental Health. Presented is an approach toward uniform reporting.*

By ANITA K. BAHN, B.A.

THIS OUTLINE summarizes the needs of different groups or organizations for information on mental health clinics, on the kinds of clinic data which can be gathered to meet these needs, and on the techniques which can be utilized for collecting clinic information on a wide geographic basis. Although the outlined items relate specifically to clinic services, they have wide and general applicability to uses of statistical data for many health department services as well as for services of many other agencies with a need for meaningful statistical data.

If this picture of consumer demand for clinic statistics appears somewhat complex, it is because the situation is complex. This does not mean that the problems of clinic statistics are insoluble. Rather, it is important to recognize realistically both the differences and the similarities in the needs which different agencies have for clinic information and to plan a long-range statistical program accordingly.

*Mrs. Bahn has been associated with the Public Health Service since 1948, as biostatistician with the National Cancer Institute from May 1948 through October 1951, and then as chief of the Outpatient Reports and Records Unit, Biometrics Branch, National Institute of Mental Health. She has also been a statistician for the Public Housing Administration, the Census Bureau, and the War Production Board.*

*This paper is based on Mrs. Bahn's presentation in Cleveland to the workshop on clinic statistics at the annual meeting of the American Association of Psychiatric Social Workers, June 4, 1953.*

## Needs for Clinic Information

There are many similarities in needs for clinic information, but different statistics can be meaningful to different groups and at different levels of operation. This point can be illustrated by listing a few of the actual and potential consumers of clinic statistics according to their function and interest, and next, depending on what level the consumer agency is functioning, by listing some of the factual information needed about clinic operations.

**1.** Public and nonprofessional groups, such as mental hygiene societies and other voluntary community organizations, which are interested

in or which sponsor mental health programs and clinics, are some of the major consumers of clinic data. Since these are typically community groups, their primary interest is to determine what are the community's mental health needs and how adequately the clinic is helping to meet those needs.

**2.** Appropriation bodies—local, State, and Federal—and other public or private agencies which provide part or all of the clinic's operating expenses want to know how the clinic's operating funds are being spent and whether the most effective use is being made of clinic resources.

**3.** Professional organizations, both single-discipline and interdiscipline associations, have a natural and valid interest in data which will indicate the nature of their professional practice or role in clinics and the professional standards that are being followed or that will assist in planning professional training.

**4.** Research workers, or research groups such as universities and medical schools, may use clinic information for special socioeconomic or etiological research. This type of clinic statistics cannot usually be recorded or collected in a routine manner. In order to obtain valid results, research projects of this nature must be carefully designed in advance of the recording or collecting of data, and their scope must be carefully delineated. Since research interest in clinic statistics requires, typically, a great deal of detailed information on limited and specific areas of investigations, the statistical needs of this group will not be discussed here.

**5.** Individual clinics, clinic boards, State mental health authorities, and local councils of clinics and social agencies may be included among the operating agencies themselves. Although operating agencies utilize much of the above statistical data, they require, in addition, detailed administrative facts on the clinic's operations which outside agencies do not need but which are essential for personnel supervision, allocation of staff time, and policy decisions. The specific administrative data needed may differ, depending on the kind of clinic—whether it is a children's clinic, an adult clinic, a juvenile court clinic, an alcoholic clinic, or a training clinic.

### Levels of Need

There are, then, basic differences in the questions asked about clinics by different groups. The questions also vary somewhat, depending on whether the consumer agency is functioning on the national, regional, State, community, or local level. Sometimes data requested on a national basis, such as age and sex of patients and amount and kind of services received, may seem insignificant to the clinic which has relatively few patients. However, when these pieces of information are added up from each clinic, they provide a significant picture of services in the State, region, and Nation. There are actually both variation and overlapping of statistical needs and interests depending on the type of agency and its level of operation.

**1.** Thus, national organizations need, typically, broad clinic information to answer some of these basic questions:

How many clinics are there in the United States?

What is the typical staffing pattern for different types of clinics?

How many psychiatrists, psychologists, psychiatric social workers, and psychiatric nurses are employed in mental health clinics?

How many patients are served by mental health clinics in the United States? Is this number increasing or decreasing? What services are given to children? What kind of psychiatric disorders are presented to clinics? What are the trends in the kinds and amount of services received by patients?

**2.** State agencies and organizations require nationwide data to provide the background from which to view and review the State mental health program. At the same time, they need data relative to the services in each community within the State and to the individual clinics over which they have jurisdiction.

**3.** In the individual community, clinic councils and their member clinics have found that uniform clinic reporting can be of great help in studying community need, in improving services to patients and the community, and in reviewing clinic administration, through interclinic comparisons of services to patients, waiting lists, workload, and distribution of staff time.

**4.** The clinic's primary need is probably for

data on its own operations. However, the clinic also requires data on comparable clinics to serve as a yardstick for measuring its activities. Where the clinic is part of a community or State group of clinics, data on other clinics in the group are needed to complete the picture of the clinic's role.

### Types of Clinic Data

Enumeration of some of the types of clinic data which can be collected may be helpful in determining how factual information is needed in the broad review and planning of mental health programs.

**1.** Data on the availability of clinic services would include number and location of clinics, geographic areas served, and special groups of persons served. Indexes on the availability of clinic services in the community can be computed by determining the number of clinics and the number of clinic hours for each 100,000 persons, and also, the number of clinic professional man-hours for each 100,000 persons. Much more service is available to the community, for example, from clinic A, in which there are 500 professional man-hours of service each week, than from clinic B, which provides only 100 man-hours, although both may be full-time clinics.

**2.** Data on the services provided by clinics are among the most important clinic statistics. Among the ways in which clinic services to patients can be measured is the count which can be made of the number of services provided over a given time period; that is, so many interviews—so many psychological interviews, so many treatment interviews—in 1 month, in 6 months. This service count can be broken down into as much detail by type of service and by type of personnel performing the service as is needed.

But how much detail is actually needed?

For example, before establishing a routine record system that would burden each professional worker with the task of reporting daily auxiliary patient services such as telephone calls and the writing of letters, it should first be decided whether this minute and often "defensive" kind of reporting is worth while. Where it is necessary for management analysis to know how much time is spent on such activities, it may be more economical to obtain this information through occasional time or workload studies.

**3.** Is a tally of services the only way to analyze the services of a clinic to the community and to the clinic's patients?

The work of the public health agencies may also be viewed in terms of the individuals or community agencies who receive the service, rather than primarily in terms of the number of services performed or in terms of the clinic personnel who perform the services. This focus has been found very useful for providing information to public and legislative groups, as well as for programing purposes.

This point of view is supported by the Working Group on Service Statistics of the Public Health Conference on Records and Statistics (*1*), which in April 1951 outlined 10 basic principles governing service statistics in public health. Two of these principles are quoted:

"The most important concept concerning service statistics is that such statistics should, generally speaking, measure services directed to individuals and their environmental hazards and not attempt to measure staff activities. . . .

"The gravest criticism of utilizing activity counts for service statistics is the fact that a false sense of accomplishment may be engendered in health department personnel. . . ."

At the same conference, it was noted that one State in its reporting plan follows the first quoted principle, by placing major emphasis on number of persons served and type and amount of service received rather than on numbers of visits and inspections made or other such measures of volume of staff activity. In reference to the second principle, the working group observed (*1*):

"When so many activities are recorded, there is severe temptation to think that every minute of the working time should be tabulated as evidence that full time and attention have been accorded the job. This leads to the desire to account for every letter answered, telephone call made, and even the time spent in preparing the activities report itself. . . . "

In terms of these two principles of public health service statistics, some pertinent ques-

tions can be asked about the individuals who received mental health clinic services. Answers to such questions will help to show how clinic resources are being utilized and will help in the evaluation of patient services. For example: How many patients of each age and sex group in the population visit a clinic during a year? In other words, are services for different segments of the population keeping up with evidences of needs by these groups?

How much service do patients receive? The amount of service received by individual patients can vary from 1 interview to well over 200 interviews. Because of differences in types of clinics, one clinic may see annually 1,000 patients for 1 or 2 visits each, whereas another clinic may see 100 patients from 5 to 75 visits each. It is important, therefore, to have some factual information on the amount of service received as well as on the number of patients.

For different age groups represented at the clinic, what are the problems uncovered or diagnoses made?

How many patients does the clinic treat?

What is the average amount and duration of the therapy?

Who gives treatment to various kinds of patients?

How does the outcome of therapy relate to diagnosis and to type, duration, and amount of therapy?

How many cases are terminated before planned services have been completed?

What are the reasons for the unsatisfactory termination of the case?

What is the probability of readmission?

In the area of patient services, the kinds of useful statistical questions that can be asked are almost limitless. So also are the kinds of useful cross-tabulations that can be made from data such as age, sex, amount of service, and outcome of therapy, particularly if punchcards pertaining to a large number of patients are available.

**4.** Data on the extent to which clinic activities are directed to the general community and community agencies, rather than to registered clinic patients, are valuable because of the increasing emphasis on community-oriented services, such as public mental health education, inservice mental health training of professional groups, and consultation services to other community agencies, in public mental health programs. Here again, there may be interest in several facets of the subject:

What community agencies make use of this type of clinic service?

What kinds of services are given?

Who in the clinic provides the services?

Is there any way of determining whether these services are of value other than from the fact that they are in demand?

In counting community services, either the number of different kinds of activities or the number of man-hours used for such activities might be recorded. The latter method is preferable because it provides a valid method for adding up different kinds of activities.

**5.** Or, the clinic might be looked at from a different focus, and questions might be asked about its administration—utilization of staff time, workload, or cost, such as:

How many professional persons are employed in mental health clinics?

What were the employment trends during the last 5 years?

To what extent are clinic staffs interdiscipline groups or composed of the basic clinic team?

Given the most desirable interdiscipline ratios of psychiatrists, psychologists, and psychiatric social workers for clinic teams in different types of clinics, how many additional persons of each profession would be needed to complete the staff of existing clinics or to staff clinics that may be planned for the next few years?

What training activities for the various professions are under way in the different clinics?

During a given month, how much professional time is used for patient services, community services, training, staff conferences, dictation, and other administrative work?

How many patients are there in active status on a given day?

How many of these patients are undergoing long-term treatment on a weekly basis? Semiweekly basis?

How many patients are on the treatment waiting list for 1 month? Six months?

Information is needed which shows how professional man-hours for different disciplines are

distributed by activity and by case. Comparable, and perhaps nationwide, data are needed in this area so that clinics can review their experience with that of similar clinics and determine whether their staffs are being used in the most efficient manner. However, this workload information is of less interest to public, community, and supporting agencies than are data that will indicate the kinds of services provided, who are the recipients of such services, and how much the services cost.

There appears to be an increasing interest on the part of appropriation agencies in obtaining data on the cost of clinic services:

What is the mental health clinic cost per capita population in the country and in different communities?

What is the clinic cost for each interview hour? For each community service hour? For each professional man-hour? For each type of patient?

**6.** Data on the referral source of patients are another type of information which may be quite valuable to the clinic or local council of clinics. These data may indicate the extent to which different community agencies are being served by the clinic or are cognizant of the mental health clinic as a resource. These data may also indicate patient or family awareness of a psychiatric problem.

In the collection and interpretation of referral data on a national scale, however, there are some difficulties. Knowledge of the local mechanism of referral and of clinic policy is essential for interpretation of referral data. Some clinics connected with schools, for example, do not accept patients without school referral. Families are therefore automatically referred through the school and counted as school referrals, although their attendance at the clinic is actually self-motivated. Several other types of clinics accept patients only through agency referrals. Also, where there is both self- and agency-direction to the clinic, "self-referral" and "agency-referral" are not defined in the same way by different clinics.

**7.** Data on applications pending or waiting lists can also be useful to the clinic and community, as indications of immediate demand for services. However, here again, knowledge of the local situation is necessary for careful interpretation of the data, particularly if they are to be used as indexes of the community's unmet needs.

The community's referral mechanism and the clinic's application policy will have a marked influence on the number of applications pending at a clinic. Some clinics may not accept applications for temporary periods of time. Also, where the clinic has a long waiting list of applications, this becomes known to referral agencies and persons who are seeking clinic services, and applications are not made. Some other method must be found, therefore, to obtain reliable data on the need for clinic services, if this information is desired.

### Collecting Uniform Data

Several methods that may be used for collecting comparable clinic information on a national or wide geographic basis are: the use of a national report form for collecting minimum basic data from all clinics; the development of a model reporting area in clinic statistics and the use of sample surveys for the collection of more extensive information. These methods are not contradictory but can be used to supplement each other to get meaningful clinic information; it is necessary, however, to fit the method to the need and to the type of data to be collected. All three methods may be considered pieces of a long-range clinic statistical program that must be developed on a cooperative basis.

It is expected that, in addition to any plans that might be made for collection of data on a broad geographic base, individual clinics, councils, and State agencies will want to collect, either routinely or occasionally, some information to meet their own particular needs or interests.

**1.** The use of a national summary report form is geared primarily for the routine collection of a minimum of basic information from all clinics. Such is the annual report form for psychiatric outpatient clinics proposed at the Second Conference of Mental Hospital Administrators and Statisticians in 1952 (*2*) and subsequently developed by the National Institute of Mental Health of the Public Health Service in cooperation with State mental health authorities and professional organizations. Now that

the preliminary revisions and some trial experience have been completed, the report form was to be used voluntarily on a nationwide basis beginning July 1, 1954 (*3*).

The principal advantage of a uniform summary report for all clinics is that it can provide a nucleus of comparable basic information on nationwide clinic services. This information can then be used as a point of departure for further investigations or as the "universe" for sample studies on clinic activities.

Frequently overlooked, however, is the fact that a routine reporting system can be somewhat flexible. As a result of experience with the uniform report form or because of changes in clinic emphasis or policy, new items can be added to the form, and other items can be deleted, or classifications can be changed. Also, where there is little change in some of the data from year to year, the information requested can be put on a cyclical basis.

The meaning of "cyclical" reporting may be illustrated by examples of the data on terminated patients requested in the annual report form for psychiatric outpatient clinics. The assumption is made that 5 or 6 basic facts about each patient and the services he receives will be recorded on each case record, analogous to the information recorded on all patients in other medical institutions. The national report form requests that these patient data be cross-tabulated in certain ways. After experience with the new form has been accumulated over a number of years, it may be evident that there is little change in some of the data from year to year and that it is worth while to request, one year, data on age by sex, and, in alternate years, data on age by amount of service received. Or, in one year, data might be requested on amount of service for all terminated patients, and in alternate years, for terminated treated patients only. If advance notice is given and the number of cross-tabulations in any one year is kept to a minimum, the clerical work in the clinic would not be augmented by modifying the kind of cross-tabulation requested.

Where the information on a national report form is not requested retroactively, clinics can make provision to include such information on their own record forms and to transcribe it on the national form in a routine manner.

Data on terminated patients requested in the new national form may be prepared in a number of ways—from punchcards which are tabulated mechanically, from cards tabulated manually, or from listings and worksheets. When more clinics, clinic councils, and State mental health authorities are cognizant of the advantages of punchcards, attempts will undoubtedly be made to explore all possible resources in order to utilize punchcard equipment which may be readily available.

**2.** Experience with a model reporting area in the field of mental hospital statistics may be cited as an example of how more extensive information can be obtained in a large-scale collection of clinic data, particularly through punchcard methods. A model reporting area of the mental hospitals in 15 States has developed as a result of the three recent Conferences of Mental Hospital Administrators and Statisticians. The 15 States composing the area are Arkansas, California, Illinois, Indiana, Kansas, Louisiana, Michigan, Nebraska, New Jersey, New York, Ohio, Pennsylvania, Texas, Virginia, and Wisconsin (*2–4*). Representatives of the States meet annually, and have since 1951, to arrive at uniform definitions, minimum number of basic tabulations, and appropriate methods of statistical analyses. By mutual agreement, these States collect and tabulate data in addition to those requested in connection with the mental hospital census conducted by the National Institute of Mental Health of the Public Health Service. The use of machine tabulation methods in these States has made feasible such additional tabulations.

A model reporting area in the field of mental health clinic statistics, composed of State mental health authorities and possibly community councils, which utilize punchcard procedures for tabulating patient reports, could operate in a similar fashion. For example, additional items of information could be collected on terminated patients if desired, or the group might decide to cooperate in a 1- or 2-year special study on a subject in which there is mutual interest. If a definitive study were desired on some particular type of patient or disorder presented at the clinic, it might be more readily accomplished as a cooperative project among all clinics represented in a model report-

ing area in a 1-year study than if an attempt were made to collect this information in a single clinic or single State. In order to have enough cases for valid deductions, a small clinic might find it necessary to collect this information over a number of years.

**3.** The use of sampling techniques is another method of collecting clinic information on a broad scale. To illustrate how this method would work, imagine, at some designated location, a national file of punchcards summarizing the data reported on the new annual clinic report form for each outpatient psychiatric clinic in the United States. The clinics represented by these punchcards would be readily classified into homogeneous groups or strata, according to such factors as type of clinic, auspices, number and type of employees, number and kind of patients served, average amount of service received by patients, and community and training activities. From each group or stratum of clinics, 5, 10, or $x$ percent of clinics could be selected at random to represent that particular stratum of clinics. Together, all such randomly selected clinics would represent an unbiased stratified sample of clinics in the United States that might agree to participate in an occasional survey.

Workload studies, such as census of patients in active status on a particular day, staff time studies, and cost analyses, are well adapted to sample studies, particularly if these data are not needed for small geographic units.

The obvious advantage of sample surveys is that only a relatively small proportion of the clinics are called on to supply the extra data. Yet, sample data, if properly collected, weighted, and interpreted, yield inferences applicable to the universe sampled. For each new study, samples of clinics can be reselected so that no single clinic would tend to be overburdened with supplying special data. However, it is desirable first to have basic data which describes the universe of clinics so that a sample can be properly selected.

Any data that would be available in a national file of punchcards, as the result of the collection of information on the new national report form, would certainly be made available to any accredited agency for the selection of clinics for sample or other studies. For example, if it were desired to study psychiatric social work services in mental health clinics throughout the United States, it would be possible to select a representative sample of clinics for query instead of querying all clinics in the country, and there would be a resultant saving of time and money to the clinics and to the group making the study. Thus, the use of sampling techniques makes accessible, in an economical manner, a rich reservoir of clinic information.

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*The Biometrics Branch of the National Institute of Mental Health of the Public Health Service is interested in learning of statistical projects and experiences which could serve as pilot studies for similar studies on a larger geographic scale. Copies of the new summary report form mentioned in the outline are available on request.*

# Control of the Environment For the Health of Mankind

A symposium of nine addresses at the dedication ceremonies opening the Public Health Service's Robert A. Taft Sanitary Engineering Center at Cincinnati, April 8–9, 1954. Each speech is presented in slightly abridged form.

## A Tribute to the Traditions Of Scientific Proficiency

PHR brief

The Public Health Service is honored because the distinguished guests who are participating in the dedication of the Robert A. Taft Sanitary Engineering Center represent every part of our national life which has an interest in the past, the present, and the future of the Public Health Service in general—and of our sanitary engineering mission in particular. This means that there are present at this ceremony representatives of industry and of government—national, State, and local—representatives of the public health and engineering professions; representatives of education and of scientific research.

The Public Health Service is also honored because the completion of this new research center is really a tribute to the traditions of scientific proficiency and administrative integrity under which the Public Health Service was founded and in which it serves the Nation today.

*By Leonard A. Scheele, M.D., Surgeon General of the Public Health Service.*

Forty-two years ago, President William Howard Taft signed the act which gave the Public Health Service its present name and also its first basic authority to range in its research efforts beyond the realm of "infectious and contagious diseases." Within a year after President Taft approved this law, the Public Health Service had set up its Stream Pollution Investigations Station in Cincinnati.

At that time the field of sanitary engineering was emerging in response to the needs of a Nation in transition from rural to urban life. Over the past four decades, sanitary engineering has made significant contributions to the conquest of many common communicable diseases. It has dealt with the health-related problems of water, food, shelter, and air. Today, in a rapidly changing technology, the environmental health problems are much broader and much more complex. This laboratory provides for the first time a national facility so urgently needed to probe the new environmental stresses and their effects on man.

Is it not fitting, therefore, that the research

set in motion more than 40 years ago by the signature of a distinguished father should now be conducted in a modern laboratory building sponsored by, and named for, his distinguished son?

# A Dedication to the Health Of Future Generations

PHR brief

In addition to honoring the memory of the late Senator Taft, we are dedicating a structure and reaffirming an idea. The structure is a place of science designed to probe and to test and to seek out answers. The idea is that the health of man is inseparably tied to the conditions of his environment. The health problems of our present environment are highly complex. They call for the knowledge of a special branch of science, the skills of a special corps of workers, the facilities of a special kind of building.

The opening of the Robert A. Taft Sanitary Engineering Center represents the fruition of that idea in today's world. It will be the Nation's headquarters for research in the science of public health engineering. It will be a focal point for inquiry and investigation into all the external factors which affect human health. It will be a center where men and women in the professions of engineering, chemistry, biology, physics, medicine, mathematics, and many other disciplines work together to develop and apply knowledge.

### Engineering and Everyday Life

Many people associate engineering with highways and bridges and great industrial machinery. Yet, from the beginning of recorded time, man has applied engineering principles to the necessities of everyday life. Sanitary engineering had its origins in the first crude efforts to gather and store rainwater for drinking purposes or to dispose of wastes effectively. Manpower and simple machines accomplished such feats of engineering skill as the water systems of ancient Egypt and Babylon.

But the early efforts were aimed largely at civic betterment and public pride. Only when the transition to urban life became pronounced did we recognize that sanitary conditions are associated with the public health.

In our own Nation, as we moved swiftly from a rural to an urban mode of life, the need became sharp and compelling. One of the first tasks undertaken by organized public health services in this country was that of cleaning and safeguarding the physical environment. For a long time, however, we proceeded on an empirical, trial-and-error basis. Only within recent times has a recognized branch of engineering developed to deal with the sanitary sciences. The people of this country owe a great debt to workers in this field. The debt is all the greater because we accept the literal wonders they have worked as commonplace.

It is a sobering fact that in many parts of the world today, such necessities of life as water and food are common bearers of disease and death. The grim shadow of pestilence lurks in every pool of stagnant water, in the squalid streets and homes. In this country, we drink water from a tap without a second thought, secure in the knowledge that the water is free from disease-bearing germs. Most Americans live in homes and work in offices and plants that are safe and comfortable and provided with decent sanitary facilities.

The science of sanitary engineering has, to a considerable extent, made this possible. Engineering has produced and shaped the facilities which protect millions of people against epidemics of typhoid fever, dysentery, and cholera. The control of insects, vermin, and rodents has contributed to the diminishing incidence of malaria and plague.

The water and drainage systems, the control of on-the-job hazards, the countless machines and installations built to protect the public health—all are monuments to the achievements and potential of engineering research and prac-

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*By Oveta Culp Hobby, Secretary of Health, Education, and Welfare.*

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tice. More than 40 years ago, Public Health Service workers set forth the fundamental relationship between typhoid fever and polluted waters. Many of their studies were made in this laboratory—first established in 1913, in the old Kilgour mansion in Cincinnati.

### New Problems, New Challenges

We live in an age of change. Man's relation to his environment is affected not only by change itself but by the speed of change. Not so long ago it was quite apt to apply a metaphorical label to a period of time, and call it the era of coal, or steam, or of power. Today, changes come in such bewildering succession that it is difficult to pinpoint anything except the fact of change itself. We live in a chemical age, an atomic age, and an age of jet power all at the same time.

The effects of change on our physical and social environment, of course, have been tremendous. We are buffeted by noise, subjected to internal and external tensions, harried by the increasing tempos of our civilization. The air we breathe, the food we eat, the water we drink now contain chemicals and synthetic materials undreamed of a few decades ago.

In the last 50 years, the population of the United States has doubled, and is increasing at the rate of 2 million a year. The urban population has tripled since 1900. The output of industry and agriculture has increased sevenfold. Literally tens of thousands of separate organic chemicals are among the wastes now dumped into water supplies by our expanding industries and cities.

The dangers implicit to the health of the people in this enormous growth cannot be ignored. More people, more cities, and bigger industry mean more wastes discharged into the lakes and streams. How will this affect the supplies of water for drinking, for agriculture, for industry, for wildlife, and for recreation? There is no longer certainty that present treatment methods can continue to cope with the wastes and byproducts of new technology.

The use of atomic materials has brought another entirely new set of environmental problems. President Eisenhower, in his December 1953 speech to the United Nations, clearly marked the course of this Nation in harnessing the power of the atom for peaceful purposes. And in his February 17, 1954, message to the Congress on the Atomic Energy Act, he envisioned wide industrial participation in the uses of atomic energy for the production of civilian goods and services.

But we must make sure that the expanded use of atomic substances does not injure the public health and safety. How can radioactive wastes, for example, be disposed of safely and

The White House,
Washington, D. C., April 2, 1954.

The Honorable Oveta Culp Hobby,
The Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

My best wishes to you and the staff of the Department of Health, Education, and Welfare on the opening of the Robert A. Taft Sanitary Engineering Center. In giving Senator Taft's name to a center dedicated to a healthier America, we remember a great American in a most fitting way. During the course of his brilliant public career, Senator Taft worked unceasingly for the better health of the American people. Few areas of research are more important than man's relations with his environment—his home, his place of work, his food and water, the very air he breathes. These days the employment of substances and materials, completely new or hitherto little known, is rapidly increasing. Health—and sometimes lives—depends on wise and prudent use of them. Research, consequently, is more necessary than ever before. We must continue to develop techniques that will protect the public health and at the same time foster industrial and community growth and improved living conditions. This is the mission of the Robert A. Taft Sanitary Engineering Center—a mission that does honor to the man whose name it bears, and to the 80th Congress that conceived and supported the project. I wish you and your associates every success in this important undertaking.

Dwight D. Eisenhower.

surely? The scientists of this laboratory will have a vital part in developing the knowledge that will protect the people of this Nation as they use the atom for peace and prosperity.

There are a host of other problems growing out of our modern, urban, highly industrialized society. Air pollution, for example, is not only a 20th century nuisance but may be a real menace to human health. The tragedy at Donora, Pa., in which 20 people died and half the town's population were ill during a 4-day smog, brought this home with dramatic intensity. Across the country—in New York, Charleston, W. Va., St. Louis, Los Angeles—irritations of the eyes, nose, and throat have been traced to polluted atmosphere.

### The Dedication

We look with high hope to this laboratory to obtain the information which is so essential to the Nation's health. We are confident that it will live up to the expectations of the Congress, whose concern with the health problems of our environment made this center possible.

The nonpartisan character of the legislation which authorized the Robert A. Taft Sanitary Engineering Center—the Water Pollution Control Act of 1948—illustrates the unity of purpose in protecting the health of our people. For many years, the late Senator Taft—distinguished son of Cincinnati—worked to bring about legislation to safeguard our national sources of water supply against pollution. In many ways, this center can stand as a monument—one among very many—to the untiring struggle for better health for the American people which he carried on during his public career.

President Eisenhower, in his health message of January 18, 1954, made special mention of this center and the possibilities it has in store for American health.

To dedicate, in its classical sense, means to declare or set aside. We set aside this center for study of the environment of man. We set it aside to serve the comfort and health and well-being of all Americans.

We declare it a partner in a broad alliance with industry, our schools and universities, and private and public organizations. We declare it a training center for sanitary sciences throughout the Nation and as a source of advice and assistance for State and local communities. We set this center aside as a place of scientific inquiry and as a source of the practical application of knowledge. In all humility, we dedicate it, in the tradition of American democracy, to the service of man and to the health of future generations.

# Our Twofold Responsibility In Sanitary Engineering

PHR brief

The ability of man to effect some degree of control over his environment is one of the major characteristics which distinguish him from other biological forms. It is this ability which accounts in large part for man's predominance over other life forms on the earth. Historically, attempts to control factors of the environment in the interest of health are by no means new, but the great impetus to the development of community sanitation practices has come in the last century—derived from the discoveries of science in that period.

In the United States we are blessed with the fruits of the practice of the sanitary sciences as developed to date—a freedom from the occurrence of previously common devastating epidemics of communicable diseases—a freedom which is still lacking over most of the earth's surface. We are at the same time face-to-face with a fast-growing and increasingly complex industrial development and urbanization; these are contributing to our increasing standard of living but are also producing problems with respect to the safety of our environment—the air we breathe, the water we drink, the food we eat. We must keep pace with these developments as

*By Vernon G. MacKenzie, B.S., officer in charge, Robert A. Taft Sanitary Engineering Center, Cincinnati.*

they occur, for without such progress, we do not merely stand still, we retrogress.

Our responsibility, then, in the field of sanitary science is twofold: to continue, by support of the basic sciences and engineering application, the development of practices to solve the increasingly complex problems of environmental health hazards; and, in keeping with our present global position, to provide to the less fortunate people of the world the stimulus to permit them to make real progress in their aspirations to control their environmental health problems.

There are many who say that man's ability to control his environment will react disastrously to him—not only, for example, through misuse of nuclear energy but also through the application of modern health practices in the so-called undeveloped areas of the world. The gloomy prophecies of Malthus have not yet proved themselves with respect to human populations in industrial areas, but some believe that such catastrophe has only been postponed. All these fears are only symptoms of an obligation which must be met; namely, the development of the social sciences and their application in comparable manner to our material sciences. Only in this way can we be assured that full advantage can be taken of our material well-being in national and world communities.

# Buildings Do Not Think But Men Do

PHR brief

The new building for environmental hygiene research marks a great milestone in the long and distinguished history of the Public Health Service in reducing mortality and in preventing the incidence of disease. In these accomplishments, remarkable in quality and in quantity, control of the environment along the joint fronts of engineering, biology, and chemistry has had an equally fine record.

*By Abel Wolman, Dr.Eng., professor of sanitary engineering, Johns Hopkins University.*

It is timely to recall the thought of Charles A. McCuen, of the General Motors Co.: "Neither elaborate equipment nor well-appointed laboratories can think. These inanimate things make research possible, but creative values from these things can result only from questioning, analytical minds of men."

This center, dedicated in the words of Vergil, to "the noblest motive—the public good," will rise to new heights of accomplishment or fall to the depths of mediocrity dependent on the skillful choice and the freedom of mind of its scientific staff. It renews its work with the benefit of a great heritage of previous scientific contribution. It is to till a field, national and international in scope, which is still plagued by the ancient diseases as well as those more recently added to mortality tables.

What kind of people are these scientists who breathe life into a building? How does one find and capture them? How does one measure their so-called units of work? Upon what food do they feed?

### In the Footsteps of the Giants

Josiah Willard Gibbs, Henry A. Rowland, and Ira Remsen—three men long dead—revolutionized the world in industry, in electricity, and in chemistry. A courageous statistician recently evaluated their worth to society in terms of billions of dollars. What is the nature of the scientific problem with which such men deal? Viewed by their contemporaries, they seemed to struggle with the esoteric—the useless. The importance of so-called "useless" knowledge, developed by the imaginative mind, cannot be overestimated. Faraday's comment, "How can one estimate the value of a new-born babe?" gives a universal clue to the eternal necessity of providing an opportunity for scientific work by the strange, the "crazy," the peculiar, and the unorthodox worker.

The area of the greatest opportunity for this center is to devote its best brains to unmasking the unresolved issues of a basic nature, rather

than to run the risk of permitting its energies to be frittered away in the myriads of minor development activities so easy to list and so seductive to pursue. Its field of inquiry, since disease is universal and no respecter of geography, politics, culture, or economics, although locally explored, will forever have worldwide application and significance. The stakes, as well as the fruits, are high.

That the Cincinnati workers will be placed on their mettle no one can or should want to deny. To follow in the footsteps of the giants is uncomfortable, but the warmth of their spirit likewise has an important stimulating quality. History teaches us that the great of the past can be surpassed by the great of the present. These men—Frost, Phelps, Hoskins, Crohurst, Butterfield, Streeter, Purdy, Tarbett, Hommon, Frank, and Ruchhoft—would be the first to say they only precede but do not exceed.

# The Role of Engineering

PHR brief

From its beginning as an organized profession, engineering has been aware of its responsibility for providing the social capital that spells the developing of available resources—both human and material.

For more than a century, the association of engineers with public health has been close and fruitful, and, in general, harmonious. To be sure, leaders of both professions have not always seen eye to eye, principally, when the sources and modes of spread of infectious diseases were not known or understood; when both engineering and public health were striving for a place in society; and when the lack of scientific knowledge was overshadowed by the partisanship of those who defended inadequate theories.

*By Gordon M. Fair, Dr. Ing., Abbott and James Lawrence professor of engineering and Gordon McKay professor of sanitary engineering, Harvard University.*

### History of the Sanitary Engineer

In the catechism of engineering, the question which asks for the four essentials of human existence is answered by the words, "air, water, food, and shelter." Of these, air and water are elemental and among Thomas Tredgold's "great sources of power in Nature" that the engineer is to direct "for the use and convenience of mankind." It is these great sources, and water specifically, that brought the engineer into the public health field. Food and shelter are in a sense derivative, certainly more or less individualistic in their need, and in general are less amenable to management by engineering means.

The engineer who has to concern himself specifically with the control of the environment for the health of man—the sanitary engineer—did not become established in his profession until the late 19th century, and as a unique American creation. The reason for his origin, in the Massachusetts State Board of Health, was an 1886 act of the Massachusetts General Court entitled, "An Act to Protect the Purity of Inland Waters." The vision behind his origin was that of Hiram Francis Mills, a member of the State board of health and chief engineer of the Essex Company, which owned and managed the locks and canals of industrial Lawrence.

In order to carry out the provisions of this act, an engineering department was set up in the Massachusetts State Board of Health, and a zestful group of chemists and biologists was drawn into association with the engineers of the department. At the same time, Mills offered the use of his hydraulic laboratory in Lawrence for experimentation upon the best practicable methods for purifying sewage and disposing of manufacturing refuse. This laboratory was renamed the Lawrence Experiment Station and has continued its useful existence to this day.

The impact of these developments on the evolution of public health and on engineering practice in America made the engineer a responsible member of the public health team of physician, engineer, and (later) nurse; gave the engineer the key position in a team of his own

composed of engineer, chemist, and biologist; and made sanitary engineering investigation a responsibility of public authority.

About 25 years after the events in Massachusetts, need for the control of pollution of the international boundary waters between the United States and Canada and of the great interstate streams of the United States directed the interests also of the Public Health Service into engineering channels. The Massachusetts act of 1886 had its counterpart in the act of Congress of 1912 which extended the function of the Public Health Service to include investigating sanitation and sewage and pollution of the navigable streams and lakes of the United States.

The survey of the pollution and natural purification of the Ohio River, begun in 1913, led the Public Health Service to establish a laboratory at Cincinnati. Thus, a small frame building on the banks of the Merrimack River, the Lawrence Experiment Station, became the prototype of the Robert A. Taft Sanitary Engineering Center of the Public Health Service, the great building on the wide Ohio.

### Water—A Human Essential

Since the collaboration of engineers with medical men as well as with chemists and biologists was born of the needs of a developing industrial civilization to preserve the integrity of its water resources, let us first examine the role of the engineer in the control of water for the health of man. This control, correctly anticipated by Tredgold, has been exerted in three directions: the provision of safe, adequate, and economical water supplies; the utilization of these supplies to carry away safely and economically the wastes of household and industry; and the preservation of natural waters for the use and enjoyment of man.

To these purposes, engineers have built works, some of which rival in their complexity the greatest feats of engineering in human history. The water supplies include dams that store great depths of water behind them in impoundages of vast volume, conduits that carry the collected water over hundreds of miles of hill and valley, tunnels that are many times longer than the most famous railroad tunnels in the world and that drop, in at least one instance, more than a thousand feet below the earth's surface to pass beneath rivers in their way. They include pumping stations to lift the water to communities, works for the purification of the collected water, and networks of pipes that distribute the water necessary to prevent serious conflagrations. Delivered to the piping system of the consumer, the cost to him has nevertheless been held to a few cents a ton.

### The Safety of Waste Water

But water engineering does not stop there. Most of the water supplied must be removed from the premises as spent or waste water. This has required the construction of other networks of conduits through which the waste waters flow as in underground streams to sweep away waste products that are imposed upon the carrying water. That these Augean streams may not destroy the lakes, ponds, and streams or the tidal estuaries into which most of them must discharge, treatment works of ever-increasing effectiveness have been built to make the waste waters safe for disposal. What has been done for municipal sewage has been repeated in ever-increasing volume for industrial waste waters, too.

The satisfaction for the construction of these water supply and waste-water disposal systems has accrued to many kinds of engineers, but foremost to civil and sanitary engineers. Some of them have excelled in structural design, others in hydraulics, others in foundations, yet others in purification-process designs. The civil and sanitary engineers, in turn, have called upon the services of other engineers and of scientists: mechanical and electrical engineers for pumping water and waste water and for measuring and regulating its flow; geologists for locating dams, tunnels, conduits, and ground water; and chemists and biologists for controlling the quality of the water supplied and the waste water discharged.

Closely related to engineering activities concerned with the control of water and waste water have been sanitary engineering interests—in swimming pools and bathing places, in the harvesting of shellfish and other useful aquatic life, in crops irrigated with sewage or fertilized

with sewage sludge or other municipal wastes, and in breeding places for mosquitoes that are vectors of disease or purveyors of nuisance.

### Air and the Engineer

Early interest in the control of the atmosphere and of indoor air for the health of man was erroneously directed towards noxious odors, miasmas, or malarias that were believed to be responsible for the dissemination of contagion. Not until the miasmatic theory of disease had been dispelled and the physiological relationships of air to man had been adequately explored was the engineer able to devise rational means for controlling the air of public buildings, workshops, and private dwelling houses.

Like water, air is subject to chemical and biological contamination. But its climatological condition may be such by itself that it is inimical to human health and comfort. As a result, the control of air has involved multifarious engineering responsibilities. To prevent or hold in check the pollution of the atmosphere over great cities and industrial areas, engineering designs and operations have had to concern themselves with the proper combustion of fuels and with the management of almost numberless industrial operations from which airborne waste products are released into the atmosphere. The natural reservoir of air in the earth's envelope is so great and the substance itself is so fluid that the effects of everyday air pollution have generally not been sufficiently intense to be diagnosed with precision, and catastrophes such as those in Donora, Pa., and London have been mercifully few.

The control of indoor air has been the responsibility of mechanical engineers concerned with air-conditioning, heating, ventilation, and extremes of heat and atmospheric pressure, and of chemical engineers concerned with dusts, fumes, and gases that arise from manufacturing processes and from mining and related operations. Their knowledge is often shared by sanitary engineers who have made air rather than water their principal interest. Air-conditioning, heating, and ventilation systems are designed to satisfy the physiological requirements of the occupants of enclosed spaces. These systems have contributed widely to human comfort and presumably to better health. Disinfection of the air for the control of communicable diseases spread by close contact between individuals has not yet proved itself under normal conditions of space occupancy. The control of industrial operations, however, has reduced occupational diseases markedly.

### Food and Food Wastes

Numerous health hazards are connected with the production, conditioning, preservation, storage, preparation, and serving of foods. Among these, the large-scale operations of conditioning, preservation, and storage of food have lent themselves best to control by engineering means. As manufacturing processes, they have been principally matters of heat engineering. The canning and freezing of foods and the large-scale pasteurization and bottling of milk are examples. Although these operations are conducted in a great number and a large variety of installations, the equipment used has become a product of engineering analysis, design, and production. These together with the self-regulation of industry, have made for a high degree of accomplishment in health protection. Contrariwise, the preparation and sale or serving of foods in restaurants, foodshops, and the like require so many small-scale operations that they cannot be subjected, economically, to engineering control other than that inherent in available "household appliances." As a consequence, the number of foodborne epidemics has remained extraordinarily high.

Collection and disposal of garbage and food wastes normally proceed along with the collection of other solid municipal refuse. The numerous engineering opportunities in this area include the design of the vehicles employed for the transportation of the refuse and of the means for disposal such as landfills, grinding stations, incinerators, and composting stations. The feeding of garbage to swine is less amenable to engineering control; it presents a health menace through the possible spread of trichinosis.

### Shelter, Its Present Relationship

Basic designs for human shelter are of an engineering nature. Consideration must be

given to the properties of materials, heating, ventilation, lighting, the control of noise, the provision of water, the removal of waste water and refuse, the control of vermin, and the control of accidents. Except for large-scale housing operations that require the services of engineers both in planning and execution, the principal contribution of engineers has been in the provision of suitable materials of construction and of useful mechanical equipment. Problems of a sociological nature have, as yet, not been resolved by engineering means, and possibly never will be, although there are factors in the environment that impinge upon them.

### Public Health Engineering

In America, engineering has been given important administrative responsibilities in public health and related agencies of government. Where strong sanitary engineering units have been developed in such agencies, the public has been well served; opportunities to promote the public health have been seized; and there has been good support by the engineering profession and by the general public for sanitary improvements and needed sanitary works. Where engineering units in public health agencies have been weak, there has been a splintering of responsibilities among other governmental bodies. This has not made for perspective, leadership, and experimentation. Although there has been progress, it has been emulative rather than exemplary, on the whole slow, often inadequate.

By assuming administrative responsibilities, engineers have been able to exercise important functions, among them: determination of the sanitary needs of urban and rural communities and of industrial enterprises; interpretation of these needs to responsible governmental agencies and civic groups to insure the construction of the requisite engineering works; cooperation with practicing engineers and industries in the application of modern health concepts; supervision over existing works and their effective management; assistance to legislative bodies in the preparation of sanitary laws, rules, and regulations, and arbitration of their enforcement; participation in emergency operations for disaster relief and for the prevention of epidemics allied to environmental factors; and direction of researches and investigations by which the control of the environment for the health of man has made important progress.

In these researches and investigations, as well as in many of their other undertakings, engineers have had the cooperation of chemists and biologists. Without such teamwork, progress would have been much slower.

# Social and Economic Change And Health Engineering

PHR brief

A glimpse of what sanitation was like a century ago in our own country may be had when we travel the underdeveloped countries of the world. Open water courses are used for drinking purposes, washing the body, scrubbing clothes, disposal of human excreta, and as a place for ducks and children to swim.

Lack of attention and control of environmental sanitation are in evidence in both rural and urban areas. The need for improvement in environmental health is self-evident, even to the casual observer.

### Diffusion of Cultural Patterns

Most underdeveloped areas in the world are that way because of their inability to make effective use of their natural resources. Recently, diffusion of cultural patterns from well-developed areas has proved to be a powerful stimulus to backward nations to improve their social and economic status. Global warfare, as one of its few benefits, has contributed significantly to the intermingling of people of diverse cultures and has brought about a new concept of health and well-being among the underprivileged

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*By Herman E. Hilleboe, M.D., commissioner, New York State Department of Health, and president-elect, American Public Health Association.*

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people who comprise the majority of the world's population.

The people of the "have not" areas have awakened to the fact that it is possible to speed up the evolution of their living standards, and they are impatient to get under way. Many have come to the United States for assistance—technical, fiscal, and administrative—in their efforts to achieve new social and economic benefits. For our own ultimate survival, we must help these people to help themselves, not, as some propose, by revolution that could destroy all of us, but by a scientific process that will speed up the development of their nations in an orderly manner.

Modern engineering makes it possible, John Logan, an engineer with global experience, observes, to alter completely the social and economic status of any area in the world, assuming, of course, adequate provision of health, educational, and nutritional services, public acceptance and support of the objectives, and availability of human and natural resources. An important segment of future global engineering comes within the sphere of activity of the sanitary engineer. The universal desire for health mandates the services of the sanitary engineer; he is an integral member of the health team that will have the task of improving the personal and physical environment so necessary for productivity and improved well-being.

The Robert A. Taft Sanitary Engineering Center can contribute materially to the improvement of underdeveloped countries by training research scientists for these areas and disseminating knowledge of environmental engineering. Sanitary engineers can aid in the conservation and wise use of human resources, the most potent factor in the development of backward countries.

### Environment and Health

Sanitation practices can no longer be narrowed by custom to milk, food, water, and sewage, and the prevention of spread of communicable diseases by indirect methods. There is need to extend the knowledge and influence of sanitary science into the broad fields of housing, home and traffic accidents, rodent and insect control, and atmospheric pollution. The threat to health, both mental and physical, of slum districts and poorly contrived housing projects is no longer questioned. High standards for ventilation, heating, lighting, and living space are a necessary part of advanced planning in the home, on the farm, in the shop, and in the factory.

Both adults and children need space and safe equipment for recreation and leisure activities. Mental and physical fatigue associated with the tedium of daily labor is favorably affected by rest and recreation away from the scene of economic struggle. The attainment of such recreation areas can help realize a high level of security and productiveness. To obtain these facilities, adequate funds are necessary.

Experience has taught public health workers that most legislators and most taxpayers are not very much impressed with the amount of money saved by preventive services in public health. To gain the acceptance and support of the people for our environmental health programs, we must try to express savings in understandable terms of social and economic benefits to the community.

### Civil Defense

Out of the fears created by the incredible potency of the hydrogen bomb comes a grave concern for the protection of the public health in the event of an enemy attack. An atomic blast upon a major city would create enormous havoc; care of the injured and dying would absorb all available human and physical resources.

The engineering profession has been called upon to serve as leaders, along with physicians, dentists, nurses, and other professional personnel. Provision of emergency water and food supplies, sewage and refuse disposal, decontamination of persons and material exposed to nuclear fission products—these are essential services that will help bring order out of chaos following a disaster. Optimum public health services must be maintained and even expanded to meet the threats of atomic, gas, and germ warfare. The challenges of survival stimulate group activity, in which the environmental engineer has an important role, both as engineer and as citizen.

Problems in the use of nuclear energy in peace as well as in war are heavily laden with social and economic overtones in the public health field. Technological advances in the production of electricity from radioactive strontium, the irradiation of food for its preservation, and the use, distribution, and disposal of radioactive isotopes challenge the ingenuity of sanitary engineers.

### Water and Atmospheric Pollution

After 3 years of intensive study by legislators and experts in health, engineering, and industry, a comprehensive water pollution control law was enacted in New York State in 1949. This created the New York State Water Pollution Control Board and gave it far-reaching authority and responsibility to prevent and abate pollution of the waters of the State. Included on the board are the State commissioners of agriculture and markets, commerce, conservation, health, and public works. A sanitary engineer from the New York State Health Department serves full time as the board's executive officer. An ex officio member presents industry's viewpoint in the planning stages of the programs.

The board's activities demonstrate that the social and economic life of our people can be favorably influenced by the prevention and abatement of water pollution. This is the kind of successful approach that States can use to attack water pollution problems, large or small, rural or urban, industrial or municipal.

Recent experiences in several American cities have drawn attention to the dangers of air pollution. Not only is the health of individuals threatened but also the social and economic status of the community. No one willfully comes to live in a smog-ridden city or metropolitan area overladen with smoke, noxious gases, or irritating chemicals that may become deadly without warning. The losses to agriculture are costly in areas where industry unwittingly or carelessly contaminates the air with dangerous pollutants.

In the field of atmospheric pollution, there is an unequaled opportunity for the sanitary scientist, the epidemiologist, the laboratory worker, and the industrialist to join in a combined operation to insure a more healthful environment. The dividends will accumulate in the form of better health and standards of living and a deep sense of community accomplishment for industries and municipalities.

### Tooth Decay and Water Fluoridation

Dental science has made significant progress in the control of tooth decay. The most promising development is the mass reduction of dental caries by fluoridation of public water supplies—a field in which dentists and sanitary engineers have combined their knowledge and skills to improve health and well-being, especially for growing children.

When chlorine was first added to public water supplies to prevent waterborne diseases, there was much objection to its use. Gradually, as experience taught that it was absolutely harmless in the small amounts employed and that countless lives were saved by preventing infection with deadly germs, the practice was accepted. That minimum amounts of fluoride added to drinking water effectively prevent tooth decay has been demonstrated. In such small amounts, this substance is harmless, its cost nominal, and rigidly controlled application easily accomplished.

Experts in sanitary engineering are in key positions to explain to their nonprofessional colleagues that dental decay is cheaper and easier to prevent than to treat. People understand the economics of family dental bills; no charts or graphs are necessary to convince them of the value of this public health program.

### Traffic Accidents

Radio, television, exhibits, and other means of communication all stress the safest ways to operate motor vehicles. Community organization of safety clubs, teen-age driver classes, and traffic courtesy instruction help to obtain understanding and support of the citizens for traffic safety programs. Safer highways and more efficient systems of traffic control and enforcement contribute significantly to safety on the road. No one questions the continuing need for education, engineering, and enforcement in the campaign to reduce death and disability on the

highway. But the high tide of traffic deaths and costly disabilities that engulfs an increasing number of the driving public is morbid evidence that many accident problems still remain unsolved.

That ample knowledge exists to cut down the toll from traffic accidents may be true about highway systems and motor vehicles, but, tragically, it does not apply to the driver of the automobile. Why is dangerous driving a symbol of male prowess to so many men? Why do some drivers behave as they do when behind the wheel of a machine that can be transformed in a flash into a lethal weapon?

Several medical and allied research groups are studying driver behavior, the health of drivers, the effects of various drugs on driving ability, and the dangers of fatigue and fumes in the air. Drivers with such diseases as epilepsy, heart disease, and diabetes, and excessive users of alcohol are being investigated in their role of highway hazards.

But not enough research is initiated and financed to permit full investigation of the human behavior of some drivers. The public health aspects of motor vehicle accidents deserve much more attention in highway safety programs than they have received in the past, for public health research is capable of solving many of the riddles of driver behavior. The same epidemiological techniques used so successfully in the study of communicable diseases are directly applicable to the sociological, emotional, and physical disturbances associated with accidents. The environmental engineer can team up with his colleagues in public works and with medical and social scientists to study the interaction of the driver, the road, and the vehicle.

### Social Science and Public Health

The social scientist has much to contribute to the solution of environmental engineering problems. Some of our best-laid plans fail because of social blocks that so often impede our efforts. The new type of social scientist—adequately trained and capable of doing first-class scientific studies—may be called a cultural anthropologist, rural sociologist, social psychologist, or just research social scientist, but his training in the better schools is as rigidly disciplined as that of the biological or engineering scientists.

There is a place for the social scientist in the expanding field of public health. We need to know more about human relations in a changing world that is faced with an aging population, a surplus of chronic diseases, and an environment complicated by the effects of nuclear energy; to accumulate more exact knowledge of the changes occurring in society so that the best use can be made of our resources to protect and improve the public's health; and to discover how to influence human behavior so that people will more readily take advantage of health resources.

In this pioneering field, a social scientist on the staff of the New York State Health Department is applying his special knowledge and skills in such diverse fields of study as motor vehicle accidents, the problem of community resistance to fluoridation of water supplies, and the effects of stress on illnesses and absenteeism in industry.

The addition of social science technique can reduce the lag between the discoveries in the biological and physical sciences and their application in medicine and public health. The fruitfulness of the union between public health and social science should become increasingly evident to public health workers as they successfully complete major projects that lighten social and economic burdens.

### Service, Research, and Teaching

Service, research, and teaching are the three interdependent components that comprise a modern public health program. The Robert A. Taft Sanitary Engineering Center has an opportunity and a responsibility to combine research and training so that the service that springs from such a partnership will have the quality essential for permanent benefits.

The role of government in research has assumed considerable stature within the last decade. Continued success in this role is dependent upon the establishment and maintenance of certain safeguards to insure freedom of action in both applied and fundamental research. Government research often carries with it strong

pressures—pressures that may tempt research workers to balance their programs to the detriment of work that might prove more productive.

Praiseworthy as the intentions behind such guided governmental support may be, damage to the quality of research can be done, and the true intent and purpose of scientific investigation can be misdirected. The goal of the research scientist is primarily the discovery of truths in nature, and secondarily the practical application of the results of his efforts. Attempts to dictate areas of research investigation and too great emphasis on predictable consequences will inevitably have the effect of stultifying creative imagination and reducing the scientist to the level of a technician.

Large-scale group research, another trend in modern scientific investigation, can be either fruitful or futile. Properly utilized, it can lead to results as significant as atomic fission. Improperly undertaken, it can lead to an enormous waste of brains and funds. The scientific members of a community can best decide when and under what conditions closely coordinated group research is appropriate and promising of fruitful issue.

The great scientific discoveries of the past have occurred in atmospheres of freedom and were made by men of imagination who had liberty to follow their informed hunches, guided only by the beckoning shadows cast by the evasive luminosity of truth. This is the everlasting right of men driven by intellectual curiosity, and any tendencies that might imperil this right are threats to the progress of mankind.

Therefore, government can exercise its true responsibility in research by creating conditions under which the imagination and initiative of scientists are given the widest scope and by providing adequate support, free of arbitrary provisions imposed by the exigencies of governmental policies. Acceptance of this principle will permit a greater expenditure of public funds for research without endangering the fundamental right of unfettered inquiry.

Many other problems in environmental sanitation await exploration by sanitary engineers and their associates in the sanitary sciences. Their precise methods of scientific analysis and synthesis are ideally suited to strengthen and refine program planning, execution, and evaluation in the broadening field of public health. The environmental engineer whose activities extend into the social and economic as well as the physical aspects of the community will bring credit to his profession, enlarge his own horizons, and serve the people to his full capacity.

# The Biological Sciences

PHR brief

In science, there can surely be but one world. In discussing the contributions of the biological sciences, I would want it understood that their interdependence with many other disciplines is to be assumed. Good fences may make good neighbors, but they don't make good scientists.

It is through the biosciences in particular that man has gained a fair understanding of himself, what he is, how his body functions, what his needs are, what constitutes a state of health in terms of internal processes. Man doubtless finds himself more interesting than any other species and has devoted perhaps as much attention to himself as to all other species combined. Yet, much more knowledge and understanding are needed. We must keep in mind that if man is to control the environment, he must first control himself.

### Dependency on Surroundings

Man's surroundings contain many plant and animal species, both domesticated and wild, both gross and microscopic, which influence him directly or indirectly. Man has come to appreciate that his very existence depends on the activities of many other living forms; that the carbon and nitrogen cycles of nature make his own life possible; that the remains of dead plant and animal life would mount to high

*By Oram C. Woolpert, M.D., Ph.D., executive director, the Ohio State University Research Foundation, Columbus, Ohio.*

heaven if Nature's forces of dissolution, largely biological, were not continuously active. Man has learned that he is utterly dependent on other species for food and energy supplies, being unable directly to convert the sun's energy to his own uses internally, or to synthesize certain of the organic compounds of which his tissues are composed.

Man collectively is an important element of the environment for man individually. And although this is the realm of the social disciplines, the behavioristic sciences, society is certainly a collection of individuals; again, it is man himself who is doing the behaving or misbehaving, presumably reacting to external stimuli by way of internal mechanisms.

All sciences are dependent on a biological creature, man the scientist. Useful information does not flow through the senses automatically and in an organized, intelligible form. It is inevitably conditioned by the media through which it must pass and the receptors on which it impinges. Even such an abstract science as mathematics cannot deny this relationship—the decimal system presumably had origin in the fact that man happens to have 10 fingers.

In the Darwinian era, much was said of the adaptation of life to the environment; the survival of species as a function of their fitness in relation to competing species. The grand concepts of evolution were formulated, and the foundation for a science of genetics was laid. More recently, as the environment came to be understood in precise physicochemical terms, it was recognized that fitness of the environment is equally as essential as the fitness ascribed to living forms and emerging during the course of organic evolution.

### Internal and External Environment

The environment, when closely examined, is indeed found to be marvelously fitted for life on this planet. This is notable particularly in the properties of water and carbonic acid. Among all known possible compounds, these appear to be almost uniquely suitable, not only as prime constituents of the physical world, but in maintaining that world in a state compatible with life. They serve a similarly important role for the "internal environment," the fluid medium in which man's body tissues develop and function.

While the external environment must hold to a narrow range of conditions if life is to continue, even more rigorous standards are required for the internal menstruum. Constancy of temperature, pressure, acidity, osmotic tension, and of many other properties is critically important to health and to mere survival. And while attention today is focused on the external world, it is abundantly clear that maintenance of the vital and more intimate environment within requires a continuous interchange with the outer world. Health is a matter of delicate equilibrium between the body tissues and fluids and the external surroundings. Man can get along without food—grossly ingested—for several months, because of internal stores. He can live without imbibing water for a few days. But he carries almost no stockpile of oxygen. Without it, he will die within a few minutes. Unconsciousness can be produced in a few seconds if the flow of blood to the brain is interrupted. But little can be done to alter the essential physical properties of the environment to which living tissues are so nicely adapted.

With the flowering of the biological and medical sciences beginning in the latter part of the 19th century, man acquired more understanding of infectious diseases than all the preceding centuries had afforded. Superstition and witchcraft waned; the gods and the constellations were exculpated; and empiricism in medicine—the classification and treatment of diseases on the basis of symptoms—was supplanted by sound methods based on knowledge of cause and mechanism. A rational approach to prevention of disease became possible as facts began to accumulate concerning reservoirs of disease agents, carriers and vectors, portals of entry and egress, and the properties of the agents themselves.

### Endless Environmental Problems

Ironically, man's successes have brought him new problems. The technological complexities of the machine age place him in dire jeopardy if any vital element falters even momentarily. When disaster strikes locally in the

form of earthquake, hurricane, or flood, there is immediately grave concern about food, water, medical supplies, and shelter.

Although the mechanism of most infectious diseases is now known, the greater mobility and density of population make control more difficult and more costly. Agents of disease can now be borne not only on the wings of mosquitoes and tsetseflies, but also on the wings of swiftly speeding aircraft. Within a matter of hours, exotic diseases can be transported from remote places and introduced into dense aggregations of susceptible people.

The tremendous reduction in infant mortality has brought a much larger proportion of the population through to the older age groups, presenting problems of health and adjustment about which we are not well informed. The machine age has introduced new occupational hazards and diseases. More decibels of noise and more quanta of hurry and confusion confront us all. The automobile has displaced the horse on city streets, thus eliminating the principal source of tetanus spores, but leaving a no less noxious trail of carbon monoxide.

### Keeping Pace With Technology

To meet the growing demand for food from a finite acreage of arable land, agriculture has resorted to the wholesale use of insecticides and thus has raised some serious problems of toxicity for man. Could it be that the worm we fail to find in the apple has been repelled by pesticides which we also should shun? More information is needed about the effects of some of the insecticides, especially compounds which can accumulate in soil and in plant and animal tissue. Meantime, new insect pests are appearing, and resistant strains of well-known species are developing selectively, so that new insecticides and new formulas must be sought continually.

Industrial wastes in ever greater amount and variety pollute surface waters. More information is needed about the biological effects of many of these compounds and how to reduce or remove them. The disposal of sanitary wastes too is becoming increasingly difficult and costly as demands for water continue to mount and the supplies of this precious resource, once thought of as boundless, shrink before our very eyes. Here knowledge, biologically at least, seems reasonably adequate, but disposal facilities scarcely keep up with the increasing load.

The industries which are largely responsible for contamination of the atmosphere will be concerned with improvement of equipment and processes to minimize it, but it is the biologists who will continue to wrestle with the problem of effects on plant, animal, and human life. Much more knowledge is needed about the results of repeated minimal exposures and the effects on different age groups and on those already suffering from respiratory or cardiac disease. It has been suggested recently that the high incidence of lung cancer in urban areas might be related in some degree to these irritants. Only long-term studies in the laboratory and the field can give valid answers to problems of this kind.

Some thought now must be given to radioactive elements in the atmosphere and in surface waters as the result of accidental or incidental contamination. Physicists and engineers will put them there, but biologists will be called on to interpret and minimize the effects on living tissue. More information is needed about the long-term effects of ionizing radiation. It is known that the rate of genetic mutations can be increased by radiation. Cumulative effects in large populations might be very significant.

In this era of cold war or tepid peace, there is ever present the possibility of hot war. If another world war were to break out, it must be assumed that hostile forces might seek to exploit knowledge of the agencies of disease in order to make our environment as unhealthful as possible. The very sciences which helped man master many of the transmissible diseases of men, animals, and plants might thus be turned against him openly or covertly, adding immeasurably to the burden of our health services and possibly setting us back many years in our progress toward a more healthful world. This negative or destructive role in which science is sometimes found is deporable, but it cannot honestly or prudently be overlooked.

The problem of man and his environment thus is a never ending one, requiring that he be eternally vigilant and progressively adaptable.

# The Physical Sciences

PHR brief

By control of the environment for the health of man, in its broadest sense, is meant the control of every aspect of the universe surrounding a man which might conceivably affect his internal well-being. A very great number of physical, chemical, biological, personal, and spiritual elements of an individual's environment can affect his health.

The role of the physical sciences in the control of man's environment is too broad a problem to be dealt with adequately. Rather than catalog the examples of the ways in which the physical sciences have contributed to the material well-being of man, it would be more constructive to pick out some single example, such as certain aspects of the conscious control of tuberculosis, and to trace how the physical sciences have contributed to this control. The main method of prevention is one of limiting the individual's contacts with the tubercle bacillus, or, one of controlling man's biological environment. I have chosen this example because of the clarity with which the contribution of the physical sciences to public health can be seen.

A large variety of factors have contributed to the decline in the death rate from tuberculosis, but the Framingham, Mass., experiment demonstrated that the application of specific control measures can reduce the rate still further. When it was found that careful examination by X-rays of presumably well people is required to find tuberculosis cases in early stages, it became a known fact that the mass chest X-ray survey is a powerful method for controlling man's environment.

In many concentrated population areas today, mass chest photoradiography surveys have been conducted and are being conducted. It is practically possible to do this only because of the availability of methods for recording chest radiograms on small-sized photographic film. I want to examine here those fundamental findings in the physical sciences which make possible this particular control of man's environment. All of the important physical principles which make mass photoradiography possible today were known before the end of the 19th century.

The photoradiograms used in mass surveys are made by photographing on a small film a fluoroscope pattern of the examined area of the body. These small film images are then used as a screening device. Experience has shown that approximately 6 percent of supposedly healthy individuals show on the small photoradiograms shadows which require investigation by direct roentgenography, using the large-sized film. Approximately 2 percent of the population examined show ultimate evidence of tuberculous lesions.

When we analyze the apparatus used in obtaining a small film photoradiograph, we find that there are three elements involved. One is an X-ray generator, another is a fluorescent screen, and the third is a photographic camera. Thus, our ability to conduct such a survey is grounded on our knowledge of X-rays, of fluorescence, and of photography.

### The History of the X-Ray

X-rays were discovered by Wilhelm Konrad Roentgen, who held professorships of physics in three German universities, Giessen, Würzburg, and Munich. Late Friday evening, after all of the research assistants had gone home, Roentgen remained in his laboratory at Würzburg. This was November 8, 1895. He was studying the properties of the cathode rays obtained when an electric current is discharged through a gas at reduced pressure. He had completely enclosed the discharge tube in an opaque covering, and yet he observed that, when the current was discharged through the tube, some fluorescent material nearby emitted a faint glow. Roentgen realized the implications of this observation. He must have worked furiously the next few weeks, because his findings were announced in the December 1895 issue of the *Sitzungsberichte der Würzburger Physikalischen-Medicinischen Gesellschaft*, and this

*By Max A. Lauffer, Ph.D., head, department of biophysics, University of Pittsburgh.*


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was followed in March 1896 by a second communication giving further details. The following are quoted directly from a translation of Roentgen's own announcement:

"If the discharge of a fairly large induction coil be made to pass through a Hittorf vacuum tube or through a Lenard tube, a Crookes tube or other similar apparatus, which has been sufficiently exhausted, the tube being covered with thin, black cardboard which fits it with tolerable closeness, and if the whole apparatus be placed in a completely darkened room, there is observed at each discharge a bright illumination of a paper screen covered with barium platino-cyanide, placed in the vicinity of the induction coil, the fluorescence thus produced being entirely independent of the fact whether the coated or the plain surface is turned toward the discharge tube. This fluorescence is visible even when the paper screen is at a distance of two meters from the apparatus. . . . We soon discover that all bodies are transparent to this agent, though in very different degrees. . . . A single sheet of tin foil is . . . scarcely perceptible; it is only after several layers have been placed over one another that their shadow is distinctly seen on the screen. . . . If the hand be held between the discharge tube and the screen, the darker shadow of the bones is seen within the slight dark shadow-image of the hand itself. . . . Lead of a thickness of 1.5 mm. is practically opaque; and on account of this property this metal is frequently most useful. . . . Of special significance in many respects is the fact that photographic dry plates are sensitive to the X-rays."

### Description of the New Rays

It is amazing how much is contained in this first report. First of all, it is obvious that in the discovery of X-rays, Roentgen made use of the previous studies of Hittorf, Crookes, and Lenard or the discharge of an electric current through rarified gases, and he also made use of the phenomenon of fluorescence previously investigated by Stokes. He reported the effect on a photographic plate of X-rays, and he describes the first roentgen-ray shadowgram, namely that of the bones in the human hand. In spite of this, his announcement contains no comment upon the possible medical implications of this use of X-rays.

Roentgen was apparently more interested in elucidating the properties of these newly discovered rays. I illustrate this by some more quotations from his first two publications:

"X-rays cannot be concentrated by lenses; neither a large lens of hard rubber nor a glass lens having any influence upon them. . . . It is well known that Lenard came to the conclusion from the results of his beautiful experiments on the transmission of the cathode rays of Hittorf through a thin sheet of aluminum, that these rays are a phenomenon of the ether and that they diffuse themselves through all bodies. We can say the same of our rays. . . . Other substances behave in general like air; they are more transparent to X-rays than to cathode rays. . . . A further difference, and a most important one, between the behavior of cathode rays and X-rays lies in the fact that I have not succeeded, in spite of many attempts, in obtaining a deflection of the X-rays by a magnet, even in very intense fields. The possibility of deflection by a magnet has, up to the present time, served as a characteristic property of the cathode ray. . . . I, therefore, reached the conclusion that the X-rays are not identical with the cathode rays, but that they are produced by the cathode rays at the glass wall of the discharge apparatus. This production does not take place in glass alone but as I have been able to observe in apparatus closed by a plate of aluminum 2 mm. thick, in this metal also."

### Discovery Probably Accidental

From a reading of Roentgen's original announcement, it seems probable that the discovery of X-rays was purely accidental; that he was simply trying to investigate further some properties of cathode rays studied earlier by Crookes, Hittorf, and Lenard.

Indeed, this conclusion is attested to by one of his students. Once he discovered these rays, his first concern was obviously to understand their nature. While he himself made the first practical application of his rays, he described this in one sentence. It is also interesting to observe that all of the scientific principles in-

volved in present day small film photoradiography were known to Roentgen himself at the time of his first publication. He knew how to produce X-rays; he knew that shadows could be produced by human tissues of varying densities; and he knew that these shadows could be observed either on a fluorescent screen or by direct action on a photographic plate. There is no evidence that Roentgen profited directly in any way as a result of the enormous use to which X-rays were put, almost immediately. He apparently took out no patents and entered into no commission agreements with apparatus manufacturers. He did, of course, receive the first Nobel Prize in physics.

### Other Great Contributors

It was Roentgen's interest in the fascinating phenomena accompanying the passage of an electric current through a gas under reduced pressures which led him to the accidental discovery of X-rays. These prior phenomena were described lucidly by Johann Wilhelm Hittorf, professor of physics and chemistry at Münster in *Annalen der Physik und Chemie* in 1869. Another person who had studied this same intriguing physical problem was Sir William Crookes, the British physicist. In 1879, he published his Bakerian lecture entitled, "On the Illumination of Lines of Electrical Pressure and the Trajectory of Molecules" in the *Philosophical Transactions* and described his own researches in this field. Another investigator whose work was known to Roentgen was Philipp Lenard. His researches in this field led him, in 1900, to a correct interpretation of the photoelectric current.

Roentgen needed to know more than the experiments of Hittorf, Crookes, and Lenard on the passage of electric currents through gases. He needed to understand the induction coil and, of course, he made use of a fluorescent screen in his initial observation. Michael Faraday, the director of the Royal Institution, was the man who investigated induced currents and invented the induction coil. He described his work on electromagnetic induction in a paper published in *Philosophical Transactions* in 1832. But, of course, Faraday's studies were carried out with full knowledge of the work of those great contributors to the physics of electricity who had preceded him. Among them were Ohm, Ampère, Oersted, Volta, Galvani, Coulomb, and Franklin.

### The Use of Fluorescence

Roentgen used fluorescence in his discovery of X-rays, and this same phenomenon is involved in microfilm procedures for mass X-ray surveys. Fluorescence was first described in detail by Sir George Gabriel Stokes of Cambridge University. His studies were published in the *Proceedings of the Royal Society* in 1852. The following are quotations:

"The author was lead into the researches detailed in this paper by considering a very singular phenomenon which Sir John Herschel had discovered in the case of a weak solution of sulfate of quinine, and various other salts of the same alkaloid. This fluid appears colorless and transparent, like water, when viewed by transmitted light, but exhibits in certain aspects a peculiar blue color. Sir John Herschel found that when the fluid was illuminated by a beam of ordinary daylight, blue light was produced only throughout a very thin stratum of fluid adjacent to the surface by which the light entered. . . . Several years before Sir David Brewster had discovered in the case of an alcoholic solution of the green coloring matter of leaves a very remarkable phenomenon, which he has designated as internal dispersion. . . . After having repeated some of the experiments of Sir David Brewster and Sir John Herschel, the author could not fail to take a most lively interest in the phenomenon."

Thus, it is shown in his introduction that Stokes was merely following up some interesting observations made by predecessors. Stokes went on to show that not only many solutions of naturally occurring compounds but also dried paper, previously soaked in these solutions, exhibited the phenomenon of fluorescence. He investigated rather thoroughly exactly what took place. The following quotations summarize some of his findings:

"There is one law relating to the change in refrangibility which appears to be quite universal, namely, that the refrangibility of light is always lowered by internal dispersion. The

incident rays being homogeneous, the dispersed light is found to be more or less composite. Its color depends simply on its refrangibility, having no relation to the color of the incident light, or to the circumstance that the incident rays were visible or invisible. The dispersed light appears to emanate in all directions, as if the solid or fluid were self-luminous while under the influence of the incident rays. . . . The appearance which the rays from an electric spark produce in a solution of sulfate of quinine shows that the spark is very rich in invisible rays of excessively high refrangibility, such as would plainly put them far beyond the limits of the maps which have hitherto been made of the fixed lines in the chemical part of the solar spectrum."

Stokes, of course, made use of his knowledge of the relationship between color of light and its refrangibility, or in more modern terms, its index of refraction. This was first pointed out clearly by Sir Isaac Newton in a paper entitled, "Theory about Lights and Colors," published in *Philosophical Transactions* in 1672.

### The Photographic Camera

The third and final element of the photoradiograph is, of course, the camera. To have a camera one really needs to know only two things, namely how to produce an image with a lens and how to record that image on a photographic emulsion. Knowledge of lenses and image formation actually antedate what we might consider the scientific era. The Arabian, Alhazen, described the lens system of the human eye about 1000 A. D., and Ptolemy of Alexandria, who lived between 70 and 147 A. D., wrote about the diffraction of light by lenses.

Recording images on photographic emulsions depends on more recent discoveries. In 1727, a German physician, Schultze, made the observation that a suspension of chalk in silver nitrate solution turned dark when exposed to sunlight. At a later date, Karl Wilhelm Scheele, the noted Swedish chemist, found that paper coated with a layer of silver chloride would be darkened by exposing it to sunlight. Credit for the first use of this blackening reaction for recording images is usually given to Thomas Wedgwood, the son of the famous potter, Josiah Wedgwood. Wedgwood knew the experiments of Schultze and of Scheele and of others who had preceded him in this study. By 1802, he had succeeded in making prints on paper coated with silver chloride from paintings on glass. This required extremely long exposure. He also tried to make photographs using the camera obscura, but failed because he could not get enough light to form an image. He published his findings jointly with Sir Humphry Davy, the English chemist, in 1802. The title of their paper was "An Account of a Method of Copying Paintings on Glass, and Making Profiles, by the Agency of Light upon Nitrate of Silver." One of the difficulties with these images was that they were not fixed; that is, on exposure to additional light the undarkened portions also darkened. Sir John Herschel pointed out in 1839 that sodium thiosulfate, or hypo, which he had discovered, could dissolve the unaltered silver salts and leave only the blackened portion. As we know, to this day hypo is used as a fixing agent in photography.

The next big step in the history of photography was the discovery of what we now call development. In 1840, Talbot, an Englishman, discovered that silver iodide in the presence of gallic acid and silver nitrate was far more sensitive to light than silver chloride. He found that it was not necessary to expose the paper until the image is formed, but that he could develop the image by applying gallic acid and silver nitrate to the paper after only a very brief exposure. Gallic acid is, of course, a reducing agent, and the photographic developers which we know today are reducers. The only thing remaining was to discover how to produce the present day type of dry gelatin emulsion for coating photographic films and plates. This development came gradually. By 1877, Wratten and Wainwright advertised dry photographic plates with gelatin emulsions.

### The Byproducts of Research

Several things are fairly clear from this historical survey. The first is that the scientific knowledge necessary for mass photoradiography was available at the time that Roentgen discovered X-rays, before the beginning of the present century. Yet, it took 30 years before

this method was developed to the point that it gained any acceptance at all, and even today, more than half a century later, mass photoradiography is still something of a novelty.

Another observation one can make from this historical survey is that not a single one of the essential basic scientific discoveries was made as the result of a deliberate attempt to find a method for the control of tuberculosis or of any other disease. Most of them were made by professors apparently trying to understand something else. Surely, if Roentgen had had a contract from some agency of the government to find a method for the control of tuberculosis, he would never have dreamed of fooling around with a Crookes tube. He wouldn't have done this even if he had been looking for some radiation more penetrating than ordinary light, because it is a fact, known even at that time, that the cathode rays obtained in the Crookes tube have very low penetrating powers. Had Stokes been working on a contract to find a method of controlling tuberculosis, he couldn't possibly have justified wasting his time trying to understand the cause of the queer blue color seen at the surface of a quinine sulfate solution when exposed to daylight. What possible connection could have been seen by a review panel between this obscure laboratory curiosity and the control of man's environment? Yet, as we have already seen, Stokes' pioneering studies on fluorescence were necessary for Roentgen's discovery. The same can be said of most of the other workers whose contributions, we know today, were absolutely essential for this control measure. Had these individuals been under contracts to find a means of detecting tuberculosis, they would undoubtedly have lost their contracts in short order.

### The Lag Before Practical Application

Obviously, the important thing for us to worry about is not how the physical sciences have been used in the past to help with the problem of control of man's environment, but rather how can they be used most wisely in the future. Our study of the past is valuable only insofar as it gives us insight into this more pressing problem.

One of the things we learned in our consideration of the past was the extremely long lag between discovery of the physical principles underlying mass photoradiography and the actual use of the method. A good many people died of tuberculosis unnecessarily in the half century between the discovery of these principles and the present time. To know how to speed up application, one would have to know something about the reasons why the present methods were not accepted earlier by the medical profession. I would venture to guess that one reason is that the method is complicated. It involves the simultaneous application of three physical phenomena, namely roentgen-ray generation, fluorescence, and photography. In order for one to make full use of a scientific principle, it is absolutely essential that he appreciate its limitations; otherwise, he will expect the impossible and be discouraged by the actual results. To appreciate fully the limitations of photoradiography, an individual needs to know a great deal about both physical science and human biology. For the future, I would seriously recommend more thorough training in mathematics, physics, and chemistry as an entrance requirement to schools of medicine.

However, merely speeding up the development of methods based on scientific discoveries to the stage where their use is accepted by the medical profession is not sufficient to insure the best possible utilization of the physical sciences for the future control of man's environment. It is necessary also to discover new basic scientific principles which can be put to use in the future.

### Support of Project Research

I think it safe to say that most people look to the universities as the source of new discoveries in basic science. The public probably feels fairly secure when it reflects upon the rather considerable financial support being given to scientific studies in universities today. Since 1940, we have witnessed a tremendous increase of academic research sponsored by the Federal Government and by various special foundations dedicated to the solution of specific problems. In addition to this, some of the great charitable

trusts have also been supporting academic research.

Recently, I had occasion to review some data provided by the Commission on Financing Higher Education and by the Biennial Survey of Education for 1948–50. By combining a few not quite comparable statistics, I was able to obtain the following approximate picture of the situation at the end of the last decade. Out of an annual academic budget for the whole country of $1.5 billion, 44 percent was spent for instruction, and 15 percent for organized research. The 15 percent can be broken down as follows: 9 percent sponsored by defense agencies of the Government, 1½ percent sponsored by agricultural and medical agencies of the Government, and 4½ percent sponsored by all others, including charitable trusts, special foundations, industry, and universities themselves.

It seems likely that most of the persons responsible for the distribution of research funds consider that grants to universities represent the support of basic research. I would like to examine the question whether this is really so. Most grants to universities are made on a project basis. A university obtains a particular sum of money to investigate a particular question in a particular budget period. There are, of course, a few exceptions, but in general this is true.

Now, what are the effects of the establishment of projects of this sort? Well, obviously, they permit the university to carry out investigations in areas which it couldn't afford to study otherwise. For example, almost no university could build or even operate a cyclotron without substantial outside support. Another effect of project research is that it determines what intellectual areas in the natural sciences are going to be developed. Under the present system, these decisions are made outside the university by the committees who allocate the funds.

### Project Management—A Pattern

However, there is a much more serious consequence of the project system. This system tends to preclude discovery of any really remarkable principle in basic science. The whole business of managing a project requires the recipient to follow a certain pattern. As soon as a professor begins work on a project, he usually has to hire highly trained assistants. It then becomes his obligation to guarantee them a certain element of job stability. This means that the professor must make it his first concern to see to it that the chances of renewal are as good as possible. He knows that he will be judged on the basis of whether or not the project has turned up any concrete findings. I hasten to add that most sponsors today are decent enough not to require patentable findings. Now, anybody with a grain of sense knows that the problem of obtaining clean-cut results obeys a sort of inverse square law. The closer you stick to what is already known, the more likely it is that you will obtain specific clean-cut significant results. But this process makes it less likely that anything truly extraordinary will be uncovered.

It is evident from the foregoing that I do not think that the present system of supporting research in the universities is the best way to encourage the development of the basic sciences, either biological or physical. Since I believe that continuing progress in fundamental science is an absolutely essential first step in the effective utilization of such science for the control of man's environment, it follows, then, that I do not believe that our universities are being utilized effectively today in relation to that problem.

Probably most of us agree that our university resources ought to be exploited to the fullest extent possible for the solution of man's pressing practical problems. The question is: What is the best way to do this? Concerning this question, I find that I have some very definite views. I believe that the university can make its best contribution to the solution of the problems of our age by concentrating on education. In fact, I believe that education is the only real business of the university. By education, I mean that which leads the student to a realization of the problems of mankind and to a recognition of his own responsibility with respect to them, and that which induces him to develop the intellectual tools to cope with them. By education, I mean, further, a process which involves, at the highest level, cooperation be-

tween the student and the teacher in the creation of new knowledge and in the gaining of new understanding.

I would judge every activity carried on by a university on the basis of the extent to which it contributes to the process of education. In the field of science, I would judge a specific sponsored research project on the basis of whether its pursuit provides a good way to educate students and whether it is apt to lead to any significant advancement in the understanding of nature. I would judge the present-day policy of supporting academic research through the medium of projects on the basis of whether this is a good way to further the educational function of our universities.

I believe that a university neither can nor should attempt to solve within its own walls very many of man's practical problems. This isn't because I am not anxious to see these problems solved: it is only because I believe firmly that pursuing such an aim will prevent a university from realizing its true function. Our job is to provide people with the means to solve these problems; this task alone is overwhelming.

### Scientist-Based Research

I feel, further, that it should be the duty and the privilege of university faculties solely to determine what intellectual areas are essential for the education of its students. I certainly recognize that this places an enormous responsibility upon the faculty, and I am fully aware of the inadequacies in the human beings like myself who make up faculties. Nevertheless, I don't think the human beings in the government or anywhere else are any more adequate. This being the case, then, I must oppose any attempt, conscious or unconscious, to direct or shape the intellectual activities of the universities from the outside. This does not mean that universities must not be influenced from the outside. It does mean that professors themselves have an obligation of being fully aware of what goes on in the world, that is, of what man's problems are. It means further that the faculties must be completely free to choose the kinds of intellectual exercises used to prepare students to face these problems.

Please be assured that I am not really advocating irresponsible discontinuation of the present support of science in our universities by the Federal Government and by other agencies. What I am advocating is an honest attempt to find ways of giving this support which will result in the greatest possible advancement of science and, therefore, in the greatest potential good for mankind. Truly fundamental scientific discoveries cannot be planned. They can be made only as the result of the alertness of a highly competent and highly imaginative scientist as he observes the day-to-day progress of his own research. I would advocate a research supporting policy which is based, not upon projects, but upon men. Assume that a certain scientist working in a certain university has demonstrated on the basis of previous performance that he is capable of making significant contributions to basic science. On this basis alone, he should receive research support for an extended period of years with no limitations beyond those normally binding a university professor to his academic duties. There should be no research reports and no visiting committees. The man should be judged only after a long period of time, and then solely upon the basis of the effectiveness of his research published in regular scientific journals. Effectiveness, I remind you, depends on quality and quantity. If this effectiveness is high, then his support should be continued even beyond the original long-term period. And, if it isn't high, then, of course, support should be terminated.

There are many examples which prove that this is a good way to get research done. While it isn't concerned primarily with physical sciences, the Rockefeller Institute for Medical Research has always operated on this system. This institution has had an enormous effect on the development of basic biological and medical science in this country. Most of the great physical and chemical laboratories in Europe and in Britain in the 19th and early part of the 20th century were operated on this same principle, and the enormous development of the physical sciences in these institutions demonstrates clearly the effectiveness of this way of managing research.

I make an urgent plea that we give serious

thought to this problem, the problem of insuring the future availability of basic science, both physical and biological, for use in the control of the environment for the health of men.

## The Role of the New Center In Scientific Research

PHR brief

The discussions which have been presented at this symposium illustrate the breadth of scientific talent and the nature of the working environment that are required for successful research in sanitary engineering. The discussions have served to point out clearly that there will be no simple formula which can insure success in this field. As we face the complex problems of our environment today, emerging with all their complexities, the prospects for sanitary engineering might be considered as either encouraging or discouraging: discouraging because of the extremely rapid development of problems in so many diverse aspects of environment, many of which will have to be approached without much guiding precedent; encouraging for these very same reasons. It is pioneering that offers a fascinating challenge.

Particularly those of us who will have some part in administering the affairs of the Robert A. Taft Sanitary Engineering Center are grateful for the insight into the technical aspects of its operation, which our speakers have given. My remarks are concerned with those far less precise but perhaps more perplexing problems of administration—problems not amenable to slide rule computation.

Two basic philosophies will become apparent as we move ahead. Much has been said about these directly—much more has been implied: first, that an institution of this type cannot attract and retain and promote scientific competency if it be geared to an assembly-line production schedule; and second, that the authorization that established this center and the public moneys that will support it do not provide for the maintenance of a scientific environment solely for the purpose of stimulating original scientific knowledge.

At the risk of a challenge, these two philosophies need not be incompatible. The problem is to maintain a resultant which represents the proper mean between these two extremes.

Brought out abundantly clear have been the broad and interrelated problems involving the equilibrium between man and his environment. Certainly this center in itself cannot hope to encompass all of these problems. Through close collaboration with the universities and other research resources of the Nation, however, we may jointly stimulate the guiding research so urgently needed to cope with them. We look forward to serving our research colleagues in the States, the universities, and industry in whatever manner will best serve the public interest. The primary energies of the center will be directed toward those problems national or regional in character and generally beyond the resources of individual State institutions and industries.

In developing the pattern of operation for the center, two questions emerge:

How best to develop the atmosphere required to attract and retain the kinds of people necessary to accomplish the center's mission?

How best to develop and maintain coordination between the applied activities of the center and the more basic research carried out by the universities?

The intelligence with which we are able to manage these two problems in a large measure will determine the success of the enterprise.

We in the Public Health Service accept the responsibility for managing this center to meet the challenges described by the previous speakers. We hope we have the potential to develop its capacity to full advantage of the opportunities it provides.

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*By Mark D. Hollis, C.E., Assistant Surgeon General and chief engineer officer of the Public Health Service.*

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# Mental Health Programs of the States

## —Recommendations Based on Studies of Current Practices—

By RILEY H. GUTHRIE, M.D.

*This report is based on two volumes prepared and published by the Council of State Governments, 131 East 50th Street, Chicago, Ill.: The Mental Health Programs of the Forty-eight States, a report to the Governors' Conference, 1950; and Training and Research in State Mental Health Programs, a report to the Governors' Conference, 1953.*

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RECOGNIZING the growing demand for more effective mental health and hospital programs in the United States and the States' responsibility in this field, the governors of the 48 States at their 41st annual meeting in June 1949 adopted the following resolution:

"Mental hygiene and the care and treatment of the mentally ill create some of the most important social and financial problems confronting the States today. In order that the States may be enabled to deal adequately with these problems much additional information is needed with respect to personnel, administrative practices, and physical equipment.

"The Council of State Governments therefore is directed to make a comprehensive factual study of the activities and facilities of the several States in this field and to submit its report to the Governors' Conference."

Accordingly, such a study was made and the report, Mental Health Programs of the Forty-eight States, prepared by a special research staff with the assistance of a technical advisory committee. Information was gathered through the offices of the governors of the States and from State mental health authorities and persons concerned with the care of mental patients.

In general, the study dealt with these questions: What are the real needs? What can be done now to meet these needs? It was recognized that answers to these two questions were needed as a basis for sound State programs.

More specifically, the study provided information on the historical background of the care of the mentally ill, the scope of the present problem, legal aspects, institutional organization and administration, financial aspects, mental hospital buildings and equipment, quantity and quality of personnel, quantity and quality of care and treatment, and special activities related to mental health and hospital programs such as community relations, clinics, programs for special groups of the mentally ill, and re-

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*Dr. Guthrie is mental hospital adviser for the National Institute of Mental Health, National Institutes of Health, Public Health Service. He was a member of the Technical Advisory Committee and of the Advisory Committee on Mental Health, which assisted in the preparation of the volumes on which this paper is based.*

search. The tables and graphs prepared to support conclusions are informative and suggest methods of improving current practices.

Preceding the presentation of the factual data in the report is a summary of the material and recommendations. This is a strategic position for them because they serve to stimulate interest in the supporting material.

### Facilities and Activities

The 40 recommendations made merit thoughtful consideration. The first, based on the finding that hospital space for the care and treatment of the mentally ill is an evident and urgent need in most States, specifies that, to the extent possible and feasible, adequate hospital space should be provided promptly. Study findings also indicated that modern equipment and facilities and additional personnel should be provided.

Studies of psychiatric needs for observation, care, and treatment of children which may lead to the development of appropriate treatment programs on a statewide basis are recommended. Such programs are essential for the early detection of significant symptoms.

Problems of the aged, including the need for community facilities for them, are given recognition.

Recommendations concerning legal aspects of patient care include these: deletion from the statutes of outmoded terminology, provision for voluntary admission of patients to hospitals, and simplification of procedures for admission of involuntary patients.

Organization and administration of hospitals for the mentally ill were found to be chaotic in some instances. To remedy this situation, it is recommended that comprehensive mental health and hospital programs be established under the administration of a single integrated State agency. The organization should follow clearly defined lines of authority.

Consideration of financial factors motivated the recommendation that patients contribute to the cost of care and treatment in accordance with financial ability, but that such ability not imply preference in hospital admission or treatment. The contribution made by the patient or his family is considered to be therapeutically advantageous in minimizing the stigma sometimes attached to hospitalization for mental illness.

The States should assume financial responsibility for public care and treatment of the mentally ill. This has reference to the divided State-county financial responsibility found in some States, resulting in serious disadvantage to patients.

In recognition of budgeting as an important function of administrative management, it is suggested that the National Association of State Budget Officers in cooperation with State mental hospital authorities study ways and means of developing improved State hospital budgets and that they report their findings to the Governors' Conference. This is a practical suggestion that could be followed without delay.

Recommendations concerning the plant and equipment specify that building programs be established to reduce existing overcrowding, that fire resistant structures be provided, and that basic standards of sanitation in respect to kitchen and dining room facilities, water supply, sewage disposal, and general housekeeping be met. These are matters of concern to health officers.

The need for adequate personnel in the various categories is mentioned, and the States are urged to appraise the existing situation and provide for the necessary professional and other staffs.

Programs of inservice education for ward personnel are recommended. These are of benefit to the patient; ultimately, the State will get increased return for the money invested in salaries.

Adequate provision for therapeutic programs, including psychiatric, medical, and ancillary activities, are considered of primary importance. With an appropriate therapy program, an institution is a hospital; without it, merely a custodial institution.

Since food is an important part of therapy, a competent dietitian should be in charge of well-organized food services.

The study well demonstrated the need for adequate and standardized records and statistics in State hospitals for the mentally ill. Recordkeeping processes need to be improved in order to have accurate and current information

relative to patients and the operation of mental health programs.

Perhaps the most important and far reaching in its implications is the recommendation that more attention be given to research in the field of mental illness.

### Training and Research

Interest of the State governors in mental health programs continued high, and in 1951 they requested the Council of State Governments to make a second study, this one to deal specifically with ways in which the States might work toward prevention and cure of mental illness. The resulting report is thus centered around training and research programs, but both by implication and direction, it goes far beyond these fields.

The report, Training and Research in State Mental Health Programs, is based on information obtained from State departments and agencies concerned with mental health and from hundreds of individual research scientists employed in State institutions. Both through its marshaling of facts on current training and research in the State systems and its recommendations for improvements, it can provide a basis for notable advance in early years ahead. The recommendations are given below.

#### *Responsibility of the States*

Each State should appraise the breadth and adequacy of its entire present mental health program in the light of future needs, and within the limits of its resources, assume necessary additional responsibilities for the early recognition, treatment, and prevention of mental illness.

Mental health training and research programs should be encouraged and supported by the States, and specific appropriations made for them.

It is recommended that a position of director of training and research be established within the mental health agency in each State to assume responsibility for the coordination of mental health training and research within the State's jurisdiction. It is recommended further that, where possible, regular meetings of the heads of all State agencies concerned with mental health be held for the purpose of integrating their efforts. A technical advisory committee, composed of scientists and educators in the field of mental health, should be established in each State to advise and assist the mental health agency and other State departments concerned in the coordination of training and research activities.

The States should encourage their mental hospitals and clinics to affiliate with teaching centers in order to encourage greater participation of State hospitals in field training and internship in the biological and social sciences. Through joint university-hospital staff appointments and other means members of university faculties should be encouraged to originate and participate in research in State mental hospitals. The State mental health advisory committee can be active in promoting close communication between hospitals and teaching centers.

All States should cooperate with the Public Health Service in the adoption of uniform terminology and statistical reporting procedures in the field of mental health.

#### *Training*

The States should appraise the personnel situations in their mental hospitals and support, where necessary, training of increased numbers of personnel. They should take steps to encourage an increase in the number of students at the graduate and undergraduate levels in the profession immediately concerned with psychiatric treatment and also in the basic biological and social sciences which affect progress in the field of mental health. State institutions which are not accredited for residency or as affiliate training centers for psychiatrists, clinical psychologists, social workers, nurses, and other professional groups should endeavor to raise the level of teaching and supervision in their institutions to secure accreditation.

More extensive and effective inservice training programs for all grades of personnel should be provided in State hospitals. In the larger hospitals such programs may be the responsibility of a training or a research and training officer.

Narrow specialization within the field of mental health does not make for the best care

and treatment of mental patients. Inservice training for all hospital personnel should include lectures and seminars designed to acquaint each professional group with the special knoweldge and skills of the other professions represented. In many cases basic courses in hospital orientation, patient management, general psychology, psychiatry, the special therapies, and the functions of each occupational group can be organized advantageously into a common curriculum for most of the hospital staff. Inservice training also should provide for interchange of experience in the actual work of the different groups so that each staff member may both understand and assist in duties other than those of his specialty.

Individual States should consider the advisability of providing stipends for graduate training in psychiatry, psychiatric social work, psychiatric nursing, clinical psychology, physical and occupational therapy, public mental health, and the basic biological and social sciences.

Salary scales should be adjusted to reduce to the extent possible differences between public and private scales so that public mental hospitals may compete effectively for the limited personnel available to fill treatment, teaching, and research positions.

Hospitals, clinics, and other agencies conducting research also should make every effort to provide those factors, both tangible and intangible, which influence morale, through administrative support of teaching and research programs.

Hospitals and other mental health facilities should use part-time services of professional persons within the community to as great an extent as other requirements permit.

### *Prevention*

The urgent need for extending the area of prevention calls for increased research to determine the relative value of various new preventive measures. Future studies, for example, should evaluate scientifically the effectiveness of early treatment measures, such as those of clinics and child guidance centers, the results of improved prenatal care to reduce congenital brain damage, new chemicals which may prevent the onset of some diseases, the usefulness of school classes in "human relations," and the results of improvement in community and family environments. Since it is generally agreed that the foundations of mental disease are most commonly developed in childhood, studies of biological, psychological, and social development of children should be stressed.

### *Research*

The kinds of training and research programs to be undertaken by the States should be determined by individual State resources and needs. The following considerations, however, should be examined closely in formulating a State training and research program:

1. States which already possess major teaching centers, especially universities or medical schools, should coordinate their training and research activities to make maximum use of these institutions and their laboratories.
2. State-sponsored research efforts should be concentrated in or near existing facilities.
3. Many significant research problems, however, especially those dealing with the effectiveness of existing treatment methods, with genetic, family, and community factors in the cause of mental disorder, and with methods of preventing it, can be pursued advantageously in many areas without large research centers.
4. The most critical prerequisite to research is scientific personnel.
5. Since successful research normally requires continuity of personnel, facilities, and financial support, the States should make every effort to assure sustained financial support, and thus avoid wasteful interruptions of the research program.
6. Excellent opportunities for important research on mental disease exist in State hospitals, even where hospital personnel lack time or training to undertake it themselves. The States should encourage use of their hospital facilities by qualified scientists from other institutions.

If headway is to be made against the rising number of admissions to mental hospitals, time and facilities for research should be made available to qualified research workers in them. Research activities in State mental hospitals should be coordinated under a research director. In small institutions, the research director may be the clinical director or superintendent; in

others, the scope of the research program may require creation of a separate position. This may be particularly desirable if responsibility for the hospital's training program also can be placed under it.

Research laboratories in State institutions should be encouraged to undertake fundamental research in the biological and social sciences as well as to seek practical solutions to immediate problems.

It is suggested that all States arrange for the use of scientific exchange services by members of their hospital staffs to increase the economy and effectiveness with which research is conducted. Staff members also should be encouraged to publish completed research findings in scientific journals and personally to present papers at professional meetings.

*Interstate Cooperation*

Where individual States find it impractical to provide adequate training for members of mental health professions in short supply, it is recommended that they enter into appropriate interstate arrangements for academic and clinical training.

It is recommended that States participate jointly in mental health research suitable for such cooperation and that they investigate practical means to cooperate in supporting and enlarging the research activities of institutions in their regions, under arrangements by which the personnel and cost of facilities and equipment may be shared equitably.

Interstate cooperation for research could be facilitated markedly through leaves of absence for hospital and university personnel in States lacking major research centers to spend periods of time at research institutions in other States.

All States should cooperate in periodic regional mental health conferences.

It is suggested that the States establish an interstate clearinghouse, the functions of which may include the following:

1. To maintain up-to-date information on the mental health programs of all States, especially with reference to the scope, nature, and results of training and research activities, and to make the experiences of each State available to all.

2. To cooperate with Federal, local, and private agencies in making maximum use of existing resources in the promotion of mental health.

3. To aid in initiating arrangements, where requested, for interstate cooperation in academic and field training and in use of existing research institutions.

4. To provide expert field consultation for States wishing more detailed assistance in establishing effective mental health programs.

**Current Developments**

Since the publication of this volume, two significant events have taken place which demonstrate that the State governors are still concerned with mental health problems and are giving considerable attention to improving State mental health programs. One was the adoption of a resolution at the Southern Governors' Conference, held November 1–4, 1953. The other was the National Governors' Conference on Mental Health, February 8–9, 1954.

The resolution adopted at the 1953 conference directed the Southern Regional Education Board to begin an immediate survey of facilities for the training of psychiatric personnel in the South and to report those best qualified to take additional students from other States; and to initiate a survey of institutions doing mental health research and recommend those capable of being enlarged to do additional research.

The resolution further specified that upon completion of these surveys, but, in any event, not later than July 30, 1954, a southern regional mental health conference be held to discuss the surveys and to draw up interstate arrangements in mental health research and training. It also suggested that the individual States make official surveys of their training and research facilities—with particular emphasis on raising mental institutions in each State to the level of residency or affiliate accreditation—and that the results be presented to the 1954 regional mental health conference. Finally, it stated that the Southern Regional Education Board be requested to report the results of its study and any action taken to the 1954 Southern Governors' Conference.

# Training of Auxiliary Personnel In Health Education in Brazil

By ORLANDO JOSÉ DA SILVA, M. D., M. P. H., and HOWARD WINSTON LUNDY, Dr.P.H.

THE SERVIÇO ESPECIAL de Saúde Pública (SESP), the agency within the Brazilian Ministry of Health which administers and operates the cooperative public health program of the ministry and the Institute of Inter-American Affairs, offered a 6-month course for training auxiliary personnel in health education in 1953. This short, intensive course was SESP's answer to the problem of obtaining specialists in health education for its staff.

Although it is the philosophy of SESP that all members of its health center and hospital staffs carry on health education activities in conjunction with the provision of services, it had been apparent for some time that persons with special training in health education who could devote full time to such activities were needed. It was recognized that such persons could help the staff do an even better job of education and could also carry on certain complementary activities within the community, such as interpreting to the people the services available at the health center and assisting community leaders to assume greater responsibility for the solution of health problems.

Persons with master's degrees in health education, however, were and still are virtually unavailable in Brazil, and even were they available, their employment would be economically prohibitive in many of the small health centers in the rural areas. The only professionally trained Brazilian health educator in the country today is on the staff of the University of São Paulo School of Public Health, and only two more will be available by the end of the 1953–54 school year, one of whom will be assigned to SESP and the other to the national malaria service. Moreover, the number of persons who can qualify for graduate training in health education is limited, and for such training they must go outside Brazil. In view of these facts, the utilization of nonprofessional, or auxiliary, health education personnel was indicated as a partial solution to the problem.

Because of a shortage of professional health personnel, as well as limited funds in many areas, SESP has used auxiliary personnel extensively. For 10 years, it has trained and employed auxiliary visiting nurses and laboratory and sanitation personnel for its large network of health centers, and, recently, auxiliary nurses

*Dr. da Silva is director of the division of health education and training of the Serviço Especial de Saúde Pública, Brazilian Ministry of Health, Rio de Janeiro. Dr. Lundy, a member of the Institute of Inter-American Affairs' field party in Brazil since 1949, is assigned to the division of health education and training of SESP as health education consultant. Between 1943 and 1949, Dr. Lundy was in health education work in State or local health departments in the United States.*

for its rapidly growing system of hospitals. Thus, SESP has had considerable experience in both the training and utilization of nonprofessional personnel.

Since the University of São Paulo School of Public Health offered a 1-year undergraduate course in health education, SESP first sought to obtain persons who had taken this course, rather than to provide training itself. Three such persons were employed, but their stay was brief. Accustomed to life in the metropolis of São Paulo, a city of 2 million people located in a rich and progressive area of the country, they were not content to remain long in the interior of the country, where their assignments took them.

The next obvious step was to select persons from the areas in which they would eventually work and send them to the school of public health. This plan proved unsuccessful because the entrance examinations were too difficult for a majority of the candidates from the interior. SESP therefore finally decided to devise and present a training course for health education auxiliaries as it had already done for auxiliaries in other fields.

### The Experiment

The professional staff of the health education and training division of SESP, who developed and presented the training course, consisted of 4 Brazilians—2 physicians, an educator, and a rural sociologist—and 2 consultants from the United States—a cultural anthropologist and a health educator. Working as a team, they planned, organized, and directed the course, and additional teachers were recruited for various phases of the training.

Students were recruited by the health centers in the areas in which they were to work, thus minimizing the possibility of their becoming unhappy with life in the interior. Candidates were given a written test followed by a personal interview, and only the best qualified were accepted for the course.

The seven SESP candidates who were accepted had completed secondary school—9 years of education in Brazil—and two of the group had had both teacher training and experience in teaching. In addition, 4 auxiliaries were trained for 2 State health departments, and 2 for the national malaria service. Two persons with a university background also took the course and completed additional special assignments. They will serve as supervisors for several auxiliaries in the SESP field programs.

The course was divided into three periods: (*a*) 1 month of observation in the student's local health unit; (*b*) 4 months of classwork at the SESP headquarters in Rio de Janeiro, including lectures, demonstrations, roundtable discussions, seminars, laboratory work, role playing, and field trips; and (*c*) 1 month of closely supervised field work in 1 of 2 SESP health centers.

It was believed that a month of observation would make the academic work much more meaningful since most of the group had not had direct contact with the health service. The classwork included 500 hours of instruction in the following subjects: anthropology, bacteriology, biology, community organization, didactics, epidemiology, first aid, health education, nutrition, parasitology, personal hygiene, psychology, public health administration, recreation, sanitation, school health, sociology, and statistics. Naturally, only basic facts were taught in some of these subjects, whereas in key subjects, such as health education and community organization, considerable detail was given.

It had been planned to use the problem-solving approach as the basis for the entire course, but, because of the differences in the backgrounds of the students and the gaps in their knowledge, it was decided to combine this approach with the lecture-seminar method. Informality was the keynote, and student participation was encouraged. During the last 2 months of the classwork, the students spent a great deal of time practicing leading of and participating in various types of conferences and meetings, with fellow students offering criticisms and suggestions.

During the supervised field work, the students had an opportunity to put into practice what they had learned in the classroom. They held numerous conferences with the staff members of the health unit to learn about their programs, problems, and interests, and helped them in planning educational aspects of their work.

They went into selected parts of the community to work with community leaders in developing plans for health betterment (plans which are now being executed with the aid of the auxiliary personnel permanently assigned to the area). They also worked with such organized community groups as parent-teacher associations and stimulated the formation of several other such groups. The staff of the health education division supervised the work of the students during this period.

### Results

Because there were still so few of them, it was decided to place the health education auxiliaries on the SESP's district health teams, until then composed of a health officer, a nurse, and an engineer. These district teams serve an average of 4 or 5 counties, giving consultant service to all the health centers and subposts in that district.

Thus, as a result of the training course, 7 of the 12 district health teams of SESP's field programs now include a full-time auxiliary in health education. It is planned to provide the remaining teams with auxiliaries as soon as additional personnel are trained. It is also planned to add auxiliary personnel in health education to the staffs of the larger health centers.

The health education auxiliaries are supervised by the head of the health education section of each SESP field program, who is either a physician or one of the university-trained persons mentioned above. The State health education sections, in turn, receive assistance from the health education division of SESP in Rio de Janeiro.

### Evaluation

In evaluating the course, it was obvious that the 1 month of field training was inadequate, and it is believed that this period should be increased to 3 months. It was also recognized that more teachers were employed than were really necessary, and that more emphasis should be placed on the social sciences. These weaknesses will be corrected in the second such course which is to be conducted in 1954 in collaboration with the health department of Rio Grande do Sul for training auxiliaries in that state.

Although it is too early to evaluate fully the contributions which these auxiliaries will make to the public health program of SESP, there is every reason to believe that they will prove as effective as have auxiliary personnel in other fields. There is already more interest in and appreciation of the educational aspects of the program than existed heretofore. With this resource person available, the staffs of both the district teams and the individual health centers are giving more attention to educational activities and are planning ways for increasing and improving them. Community leaders and groups are participating more actively in health matters, and the schools are finding another ally in the health center to assist in their health programs.

The following may be cited as examples of the contributions of the health education auxiliaries: In the huge Amazon River area, they helped the staffs of the health centers prepare an organized plan of health education activities for each health unit. In a tiny village in another area of the country, they assisted community leaders to secure funds from the townspeople for a small health post manned by a private doctor from a nearby town. In a third area, they taught the health education portion of the training course for auxiliary nurses. In many areas, they have stimulated the formation of parent-teacher associations, mothers clubs, sewing clubs, and school health clubs, and they are giving guidance to these organizations in developing health activities.

### Conclusions

In a country such as Brazil, where professionally trained health educators are almost entirely lacking and where the economy of some areas cannot support highly paid professional personnel, full-time health education auxiliaries on the staff of local health service can make definite contributions to that service and to the community. Such auxiliary personnel, of course, must have adequate supervision on a continuing

basis from professionally trained health educators.

As an initial approach in the training of such auxiliaries, an 8-month course is suggested: 1 month of observation in the health service where they are to work; 4 months of intensive classwork, emphasizing social sciences; and 3 months of closely supervised field experience in a health service and community typical of the country concerned.

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## Laboratory Refresher Training Courses

The Communicable Disease Center of the Public Health Service will present the following laboratory refresher courses at Chamblee, Ga., during 1954–55:

Laboratory diagnosis of bacterial diseases:
- September 13–24: General bacteriology (part 1).
- September 27–October 8: General bacteriology (part 2).
- October 18–29: Enteric bacteriology.

Laboratory diagnosis of parasitic diseases:
- September 18–October 8: Intestinal parasites (part 1).
- October 11–29: Blood parasites (part 2).

Laboratory methods in medical mycology:
- November 1–12: Cutaneous pathogenic fungi (part 1).
- November 15–26: Subcutaneous and systemic fungi (part 2). Part 1 or the equivalent is a prerequisite for this course.

November 15–26: Laboratory diagnosis of tuberculosis.

November 29–December 10: Laboratory methods in the study of pulmonary mycoses.

December 13–17: Laboratory diagnostic methods in veterinary mycology.

The following courses will be presented at the Virus and Rickettsia Laboratories, Montgomery, Ala.:

October 18–22: Laboratory diagnosis of rabies.

March 14–18: Laboratory diagnosis of rabies.

October 18–29: Laboratory diagnosis of viral and rickettsial diseases.

March 14–25: Laboratory diagnosis of viral and rickettsial diseases.

The following courses will be presented by special arrangement:

Laboratory diagnosis of malaria.

Virus isolation and identification techniques.

Laboratory diagnosis of influenza.

Typing of *Corynebacterium diphtheriae.*

Special problems in enteric bacteriology.

Phage typing of *Salmonella typhosa.*

Information and application forms should be requested from Laboratory Training Services, Communicable Disease Center, Public Health Service, P. O. Box 185, Chamblee, Ga.

# Public Health Manpower to Meet Changing Health Needs

THE 1954 National Health Forum, presented in connection with the 34th annual meeting of the National Health Council in New York City, March 24–26, 1954, was focused on changing factors in staffing America's health services. One of the five group discussions of the forum was concerned with the manpower needs for public health activities that emerge from changing emphases in Federal, State, and local governmental health programs.

The facts presented by the panel leading this discussion are summarized below. Following a review of major health problems of today and their effect on personnel requirements, particular attention is given to several fields of public health practice: environmental sanitation, research, accident prevention, mental hygiene, home care, and dental public health. Also included are the group's suggestions concerning problems of recruiting, training, retaining, and utilizing economically the health personnel on whom the Nation must rely for public health services.

In all the fields of activity discussed by this panel, the dynamic character of public health is clearly indicated. As one participant noted, no sooner is one health problem brought close to solution, than another arises to make even greater demands for knowledge and application of new public health techniques. Moreover, goals in public health are being gradually extended beyond the challenge of prolonging life to encompass the rewarding effort of preventing the nonproductivity that almost invariably results from illness and infirmity.

### Major Health Problems

Among the most important factors which must guide modern public health programs is, of course, the growing and aging population to be served. The civilian population of the United States increased from 150 million in 1950 to 158 million in 1954. By 1960, according to predictions, the population will consist of 169 million people, of whom one-fourth will be 50 or more years old.

The so-called chronic impairments of health now constitute the most challenging and urgent health problem. Research as to causes, prevention, and treatment needs to be continued. And widespread application of the best methods of control and amelioration now known needs to be accelerated. Scientific knowledge has increased faster than it has been possible to utilize such knowledge.

Preservation of mental health is another of today's outstanding health problems. Its importance is underscored by these two facts: The mentally ill occupy half the hospital beds in the United States (*1*); mental illnesses are responsible for more days of disability than any other cause, with the exception of heart disease (*2*).

Disabling illness from communicable diseases accounts for a loss of 100 million school days a year, according to estimates derived from data

provided by sickness surveys in the eastern health district of Baltimore (*2*). Estimates similarly derived from data provided by studies of sickness absenteeism in selected industries (*3*) indicate that illness from communicable diseases in the labor force costs $2.25 billion each year in time loss alone. We need safer, better, and cheaper methods of preventing communicable disease. Better control measures must be developed for such diseases as tuberculosis, rabies, whooping cough, trichinosis, and brucellosis. Practical control measures are not yet available for such diseases as poliomyelitis, infectious hepatitis, encephalitis, and influenza. A program of vigilant surveillance is necessary to prevent such diseases as typhoid fever, malaria, smallpox, and diphtheria from again becoming major health problems.

Technological advances that have helped in conquering many sources of infection have, in turn, created new environmental problems: occupational and household hazards; ionizing radiations; stresses and strains of noise, speed, light, and crowded living; pollution of streams, lakes, and coastal waters by industrial wastes and chemical contamination; substances and methods used in processing food; maintenance of increasingly complicated food-handling equipment; substandard housing; sanitation in areas suffering from disaster; air pollution; and a host of others.

Today's leading health problems, particularly those associated with the long-term illnesses and a chemical environment, require a wide range of professional competence and create new needs for personnel. The modern health department must differ greatly from its counterpart of three decades ago. In addition to the usual "basic" personnel, health departments require, in increasing numbers, cardiologists, psychiatrists, psychologists, X-ray technicians, veterinarians, nutritionists, medical social workers, physical therapists, occupational therapists, dental hygienists, electrocardiograph operators, health biologists, health physicists, and the like.

In the chronic illness field, persons are needed who are capable of keeping abreast of all current related research of possible significance in preventing or controlling chronic diseases. The poliomyelitis problem certainly calls epidemiologists to the fore again. Moreover, all these problems directly or indirectly create the need for additional man-hours of work from sanitation personnel and public health nurses.

**Panel Members**

Ernest L. Stebbins, M.D., dean, School of Hygiene and Public Health, Johns Hopkins University, was chairman of the discussion. Members of the panel were:

Aaron W. Christensen, M.D., assistant chief, Division of General Health Services, Bureau of State Services, Public Health Service (substituting for Otis L. Anderson, M.D., chief, Bureau of State Services).

Daniel Bergsma, M.D., commissioner, New Jersey State Department of Health.

Arthur P. Miller, C.E., sanitary engineer director, Public Health Service (substituting for Mark D. Hollis, C.E., an Assistant Surgeon General and chief engineer officer, Public Health Service).

Charles V. Kidd, director, Research Planning Branch, National Institutes of Health, Public Health Service.

Ralph Kuhli, assistant director, home safety division, National Safety Council.

Paul V. Lemkau, M.D., School of Hygiene and Public Health, Johns Hopkins University.

Lucille Notter, R.N., director, joint educational program, Visiting Nurse Service of New York and Visiting Nurse Association of Brooklyn.

W. Philip Phair, D.D.S., secretary, Council on Dental Health, American Dental Association.

V. A. Van Volkenburgh, M.D., assistant commissioner, local health services, New York State Department of Health.

### General Personnel Needs

Since 1947, the total number of State and local health workers has increased by about 7,600, or 16 percent, according to Public Health Service data. This growth has not occurred evenly, however, either geographically or among the several types of personnel. Many local health departments are still only skeleton organizations, operating on budgets of as little as 15 or 20 cents per capita. Others have budgets running as high as $4 or $5 per capita (*4*).

A countrywide survey conducted by the

Public Health Service disclosed that, as of April 1, 1951, 3,210 of the 32,764 State and local health department positions budgeted were vacant, or roughly 10 percent (*5*). Data for a few of the professional positions showed the following vacancy rates for budgeted positions: physicians, 19 percent; health educators, 20 percent; dentists, 21 percent; nutritionists, 16 percent; psychiatric social workers, 27 percent; and graduate nurses, 9 percent.

In the absence of comparable current data, the status of full-time health department physicians in New York State, exclusive of New York City, will serve as an isolated example. At present, omitting department institutional physicians, the number of such positions budgeted by State, county, and city health departments is 121. Of these positions, 20, or 16 percent, are vacant. Fortunately, 14 of these vacancies represent subordinate positions. Nine of the 20 vacancies are in the State health department and 11 in local health departments.

Bearing favorably on the shortage of public health personnel is the fact that schools of public health granted 1,905 master of public health degrees during the 5-year period 1947–48 through 1951–52 (*6*). Enrollment in these schools has been on the increase since 1950. The increase in number of staff-level public health nurses since 1937 has barely kept pace with population increases. We now have 1 nurse per 7,000 population, as compared with 1 per 7,500 population in 1937 (*7*).

Compensation of State-employed public health workers has risen also. Increases from November 1940 to August 1953 in median salaries ranged from 71 percent for directors of vital statistics to 136 percent for medical personnel, exclusive of State health officers. When adjustments are made for increased cost of living, as reflected by the Bureau of Labor Statistics' Consumer Price Index, these percentage increases drop, however, to minus 11 percent and plus 23 percent, respectively (*8*).

Personnel shortages have forced public health departments to review critically the relative needs and efficiency of program operation so that they may improve the utilization of personnel. Practicing physicians and visiting nurses are being utilized more advantageously than previously.

The shortage of public health personnel has also led to more critical public health job analysis. For example, medical health officers, in reviewing their duties, have recognized the desirability of employing nonmedical administrators for many tasks which they have been accustomed to doing themselves. Observations indicate that about a fourth of the time of a health officer is spent on activities which do not require medical judgment (*9*).

Perhaps most important is the critical evaluation of whole public health programs as well as of their component parts. Shortage of personnel may, for example, require that tuberculosis case finding be limited to efficient and thorough followup of household contacts of newly reported cases and to routine chest X-rays for all persons admitted to hospitals. When staffing facilities are limited, the most important things should be done first; the least important can be left to the last or omitted.

### Environmental Sanitation

Since World War II, two significant changes have occurred with respect to sanitation personnel:

1. Environmental health responsibilities have been broadened. Such programs as the hygiene of housing, home safety, radiological health, smoke abatement, and others require competencies beyond those traditionally needed in the performance of sanitation work. In addition, changes in program emphasis toward community participation call for methods involving more and more the concepts of psychology, sociology, community organization, and political science. The growth of technology requires an increasing knowledge of the basic sciences for the solution of everyday sanitation problems.

2. Educational levels have risen. The number of master's degrees in sanitary engineering awarded each year will soon equal, or possibly even exceed, the number of bachelor's degrees granted. Even more important, while only 52 percent of those who receive the bachelor's degree stay in sanitary engineering work, 87 percent of the master's degree recipients remain in the profession (*10*).

Although salaries for sanitary engineers and

sanitarians have risen considerably over the past 4-year period 1948–52, "increases" in real income may be somewhat theoretical. Were changes in taxes and cost of living during the period 1940–48 to be considered, for example, the "increases" would probably turn out to be decreases in real income.

In 1952, median annual salaries for sanitary engineers and sanitarians in State health departments were $5,333 and $4,223, respectively, and in local health departments $5,233 and $3,364, respectively (*11*). During 1946, engineering graduates in public employment reported a median annual salary of $4,725 (*12*). Sanitary engineers in local health departments did not reach this level until 1950—4 years later (*13*).

In 1953, State and local health departments in the States and Territories reported about 9,000 sanitation personnel. In the last 6 years, the number has increased by about 24 percent. Of these 9,000, about 8,000 were sanitarians and a little over 1,000 were sanitary engineers. While 85 percent of the sanitarians were employed in local departments, only 38 percent of the sanitary engineers were in such departments.

In local health departments, the use of sanitarians has increased by 30 percent since 1947, while the number of sanitary engineers has increased by 60 percent. Since 1947, virtually no change has occurred in the number of sanitarians and sanitary engineers employed in State health departments.

### Research

In research, the manpower problems are divided broadly into two segments: first, the supply of manpower for medical research; second, the net effect of research findings themselves upon the quantity and the nature of the demand for all kinds of health manpower.

From 1947 to 1952, our total national medical research expenditures have risen from about $88 million to $173 million. "Total national medical research effort" means research in Government laboratories, in universities, in hospitals, in foundation laboratories, and in industry (*14*).

Federal expenditures have increased, roughly, from $28 million to $73 million from 1947 to 1952. Over that period, the total private contributions for medical research have risen, in round figures, from $60 million to $100 million. About half the medical research in the country is done in universities, medical schools, hospitals, foundation laboratories, and other nonprofit institutions; about a third, by industry; and about a fifth, in Government laboratories (*14*).

Three general factors in the postwar evolution of medical research have particularly important implications for manpower.

First, the shift in the general emphasis of medical research from the communicable to noncommunicable diseases has required, or at least involved, a relatively sharp increase in the area of investigation that relates to fundamental biology, biochemistry, and biophysics. Thus, an increasing portion of the total load of medical research is probably carried by people in the basic scientific disciplines, either by persons with a doctor's degree in those fields or by physicians who have had additional training in the biological and physical sciences.

Second, the size of the research unit, on the average, has doubtless increased, resulting in expansion not only of the number of senior investigators, but also of the supplemental people on the research team. Accordingly, we face quite severe shortages of highly trained technicians throughout the whole research area.

Third, most medical research is now either a full-time endeavor or is combined with teaching, though, of course, a great deal of clinical research is done by practicing physicians.

The Federal Government is active in medical research in two broad spheres: research done in Federal laboratories, such as those of the Veterans Administration, the Naval Medical Center, the Army Medical Center, the Air Force School of Aviation Medicine, and the Public Health Service; and the support of research outside Federal laboratories, primarily those of nonprofit organizations, through contracts and grants. In 1952, the Government spent about $35 million for medical research in the first of these spheres and about $38 million in the second (*14*).

An important aspect of Federal activities relating to medical research is that the Federal

Government is a producer as well as a consumer of medical research talent; directly, through the provision of fellowships and teaching grants to medical schools, universities, and individuals, and, indirectly, through the training of people engaged in research projects and the participation of Federal employees in the teaching programs of medical schools. A large number of graduate students now receive advance training, in effect, with the support of Federal grants or contracts.

The question might be raised as to how we have managed to staff a total national medical research effort which has approximately doubled since World War II. First, medical manpower at the end of the war was probably not as thoroughly saturated with research as was manpower in most physical sciences. Second, medical research has borrowed manpower from other disciplines. Part of the supply thus comes by subtraction from the total pool of trained scientific manpower. Another important factor, of course, is the net growth in the pool of persons holding doctor's degrees in the biological or physical sciences, part of whom have been available for medical research. The total national pool of doctors in the sciences has increased from about 32,000 to 46,000 since the war (*15*). Another part of the manpower, of course, has been supplied from the pool of physicians.

Medical research, moreover, is increasingly quantitative and accordingly requires increased and extremely expensive instrumentation. Part of the absorption of money, therefore, represents more dollars per person in medical research, rather than the expansion of the total manpower required to absorb the increased funds. The expansion of medical research from this point on will be more sharply affected by the manpower factor than it has been since the end of the war.

Probably about 12,000 investigators are now engaged in medical research. Of them, perhaps not more than 6,000 are physicians—or reduced to an equivalent full-time basis, perhaps about 4,000. With a supply of around 200,000 practicing physicians, the drain of medical research upon the pool of physicians otherwise available for medical care does not seem to be a very important matter.

On the other hand, the heavy load of medical research in medical schools poses an extremely complex problem relating to the training of people for the future. Certainly, the research function in the medical schools has expanded more rapidly since the end of World War II than has the training function. The absorption of people highly competent to teach as well as to conduct research into the research function seems to be the heart of the problem, rather than the diversion of physicians from medical care.

### Accident Prevention

The leading causes of death are now noncommunicable diseases and accidents. Moreover, statistical summaries of fatal accidents in 35 metropolitan areas show that one-half of all such accidents have occurred at home (*16*).

Eight State health departments now have full-time staff members working on home safety. From 1 to 4 people in each of these States are using Kellogg Foundation grants to develop their programs. Three local health departments also have full-time staff members working on home safety.

Last year, home safety programs of a quality high enough to win merit awards were conducted by the School of Public Health at Michigan, the Minnesota Department of Public Health, and local public health departments at Cambridge, Mass.; Kalamazoo, Mich.; Madison, Wis.; Mansfield, Ohio; New York City; and San Jose, Calif.

The size of the accident prevention movement can be gauged by the fact that 13,000 representatives of industry and of local safety organizations gather in Chicago each year for a National Safety Congress.

Official State and local groups have been charged with responsibility for reducing motor vehicle accidents, industrial accidents, and even farm accidents, but, by and large, no official State or local organization has been made responsible for developing an official, tax-supported program for preventing home accidents. Therefore, the Home Safety Conference has invited public health departments to expand their programs in home safety (*17*).

Home safety is not the particular area of operation of any particular health discipline.

The pattern which has developed in health departments, so far as experts and departmental disciplines are concerned, has been that each of the various disciplines concerned in a department is represented on a department home safety committee, headed by anyone especially interested and able to point up the department's program. In many cases, the head is a public health engineer; in other cases, a public health nurse: in others, a public health educator or a public health or medical administrator, or the health officer himself.

What is needed is not a specialist, but a generalist who can integrate home safety in the total program. Home safety need not be a separate subject, but it should not be integrated out of existence.

Housing programs are usually in the sanitation division where they consider air, space, light, water supply, and other facilities, but more or less overlook home safety. Housing is one area in which greater attention could be centered on safety.

### Mental Hygiene

In this country, mental hospitalization is not a responsibility of the public health agency, as it is in most other countries of the world. It may become so now that public health is tackling the tough problems of the chronic diseases, which frequently require individual treatment. If public health ever does accept the responsibility for mental hospitals, it will inherit a job that takes between 5 and 15 percent of the total of all State budgets. It will also inherit personnel shortages of 30 to 40 percent in psychiatrists, 60 to 70 percent in psychiatric nurses, about 25 percent in psychologists, and approximately 70 percent in psychiatric social workers (*18*).

Hospital psychiatry is mostly curative or custodial medicine. What about prevention and early treatment? It is impossible to calculate personnel shortages in this area because we have no standards of operation in regard to the population to be served. We know, however, that outpatient services, wherever they are available to the public, are always in demand, and that nowhere has it been possible to satisfy demands for diagnostic and treatment services. Estimates indicate the need for a clinic team for each 100,000 people. Only about half that number is now available (*19*).

Everyone agrees that mental health concepts include respect for individual difficulties. These concepts recognize that social and interpersonal relationships may be the cause of disordered behavior, and that attitudes can best be changed in the setting of a friendly collaborative relationship, such as the confidential interview.

The attitude-changing effect of a confidential interview proves useful when the problem concerns an employee's misuse of sick leave, a head nurse's balkiness, a school child's stealing, or a young mother's anxiety over breath-holding spells. These general concepts have been referred to in connection with the need for education in psychology for engineers and sanitarians and the nurse's need for education in child growth and development, including, of course, personality and emotional development. Nursing has developed its own specialists in this area—the mental health nurse consultant.

Recognition of the usefulness of mental health techniques in the work of the health department and in voluntary agencies is usually spoken of in terms of the need for education. The need for more research is even greater, for research has had remarkable effects on the training of psychiatrists and auxiliary workers, psychologists, social workers, and nurses. With continued research and with greater contact between workers in the relatively new public health specialty of psychiatry and the longer-established workers in public health, new and demanding fields of investigation, as well as fields for mutual education, will open up.

For the most part, psychiatrists are not well enough educated in public health to grasp the problem of prevention of illness as their primary purpose. For the present at least, a tieup is needed between the educational work—the generalization of the work of the psychiatrist, the mental health expert, or the mental hygienist—and the clinical service. To obtain personnel and to maintain their professional interest, public health agencies must give the psychiatrist an opportunity to continue work directly with patients. Then the community demand must be more or less forced upon him. With increasing experience in public health

activities, the psychiatrist gradually gets the preventive viewpoint and begins to grasp educational opportunities.

The two big problems, the two major diseases that fill the mental hospitals, are schizophrenia and senility. General medicine does not give us much knowledge yet about how to stop the admission of senile patients to hospitals. We know some things about how to keep senile brains from giving rise to senile behavior, but we do not know how to prevent senility by doing anything in childhood. Moreover, we have no scientific evidence that anything done to a child will prevent schizophrenia.

Some children in school who are behavior problems can be helped through mental hygiene, to the relief of the school and of the family—to the relief of stress of all sorts within the family—and to make for more happy people. Taking the stress off people is what we all try to do in public health.

The behavior-disorder group is not a simple group, all of one kind. It includes persons with hereditary mental defects; those whose brains have been damaged by encephalitis, by meningitis, or by one of the other infectious processes; those whose brains have been damaged because their mothers had rubella or had too much anesthesia during childbirth; those with brains that have been damaged by a hemorrhage when they were born. A tremendous number of intensively difficult and exquisitely exact diagnostic problems in this area need to be solved. Then, perhaps, we will get more direct ways, better ways, of dealing with these problems.

### Home Care

Few programs have caught the public's fancy as much as have home care programs. New York City has had home care programs since 1947. Last year, the visiting nurse services made about 70,000 visits to patients receiving home care. The patients had many types of illnesses, and they ranged in age from infancy up. Compared with regular caseloads, however, home care patients included a higher percentage in the older age categories and a higher percentage of men.

Some home care programs today are being used to train medical students and nursing students. For medical students the goals are to learn the practice of medicine in the home and to learn the social aspects of medical care. We probably should add a third goal: learning to work on a home care team.

Home care is not only emptying hospital beds, it is providing services for many patients who will do much better under home care than in a hospital. Not only older people but also children can often get at home the kind of followup medical and nursing care that they need most.

We are moving to a point where we must recognize more and more that the public health nurse's job should include some care in the home and some teaching in the home. The program in New York City is pointed to the indigent, but the rationale for home care is equally applicable for the nonindigent. The National League for Nursing recently called a conference of people representing medicine, nursing, citizens groups, educators, and hospitals. The Arden House Report, representing the results of the conference, contains suggestions for a broader concept of home care (*20*).

### Dental Health

Several factors in governmental programs are very likely to affect the need for dental personnel. Present military requirements are 1 dentist for every 525 members of the armed forces (*21*), whereas the number of civilian persons per civilian dentist is 2,100 (*22*). Another potential demand for dental services will arise if the military undertakes an expanded program of medical care and dental care for dependents of the armed forces or if there is any extension of the dental services provided to veterans.

Educational programs, conducted at all levels of government, also result in an increasing demand for dental services. At the present time, about 40 percent of the population visits the dentist in any given year (*23*). Twenty years ago, roughly 20 to 25 percent of the population visited a dentist during a year (*24*). Generally speaking, we have not improved the ratio of dentists to population that we had at that time (*25*).

As a result of a topical fluoride demonstration program conducted a few years ago by the Public Health Service, hundreds of programs were set up to provide topical fluorides to children and many existing dental health programs were expanded to include this service. These developments increased tremendously the demand for dental hygienists, a demand which has been partially met, however, by the establishment of several new schools of dental hygiene.

It is doubtful whether fluoridation of public water supplies will greatly affect the need for dental personnel within the foreseeable future, but it will, in time, reduce the need for corrective treatment of dental caries. The dental profession looks forward to being able to give increased attention to gum diseases, to orthodontic problems, and to other dental health problems, as the problem of dental decay becomes less acute. Development of fluoridation programs, however, requires a tremendous amount of time on the part of the dental personnel in State health departments, as well as sanitary engineering and laboratory personnel, who are helping to promote such programs and are assisting the communities in getting them under way.

Another significant change which has been somewhat stimulated by governmental programs is the increased use of auxiliary personnel. In 1950, 65.6 percent of the dentists employed one or more full-time assistants (*23*), whereas 2 years later, in 1952, more than 70 percent were using the services of auxiliary personnel (*26*). A 1950 survey of dental practice found that a dentist with one employee served 37 percent more patients than one with no employee and that a dentist with 2 employees served 69 percent more patients than the dentist who was unaided (*23*). These data refer to technicians, clerical personnel, dental hygienists, and chairside dental assistants. Techniques in the effective use of the latter type of auxiliary personnel have been demonstrated in studies by the Public Health Service, and these techniques are now being incorporated in the teaching programs of some dental schools and are being taught to practicing dentists through clinics and films. The demand for trained dental assistants will no doubt continue to increase.

Another factor is the demonstration by the Public Health Service of the value of maintenance care programs. Two studies that have recently been completed, one in Woonsocket, R. I., and the other in Richmond, Ind., show that it takes 3 to 5 times as many professional man-hours to care for the accumulated dental needs resulting from neglect as it does to care for the dental needs of children on a year-to-year basis. Children who get dental care on a haphazard basis, just on occasion, lose eight times more teeth than children who get their care early and regularly.

### General Trends and Solutions

Governmental health programs with their changing emphases have a significant influence on personnel requirements. One of the problems in obtaining personnel to staff the changing health programs is inadequate financial compensation. Although salaries have considerably increased dollarwise, many of these increases have not meant an actual increase in purchasing power. Compensation, therefore, remains a handicap in recruitment.

The immediate need for intensive efforts to recruit candidates for education in the health profession is recognized. Attempts to interest young people in choosing a career in one of the health fields perhaps should begin in the junior high schools and should be continued, of course, in the high schools and colleges.

Vacancies and shortages in terms of ideal personnel staffing requirements suggest the necessity of investigating further the extent of personnel needs in terms of service unit requirements rather than standard ratios to population.

Critical evaluation of staffing needs, particularly with reference to the possibility of utilizing less-skilled persons, can point the way toward better use of auxiliary personnel and can help get jobs done when the professional staff is limited.

Government-sponsored research, particularly that supported by the Federal Government, has expanded tremendously in recent years, tending to attract personnel for strictly research activities from the general pool from which is drawn

the staff for many health activities. On the other hand, the fellowship and training grants that are part of the research program help to fill the gaps created by withdrawal from the manpower pool.

In addition, research provides new means of preventing and treating illnesses, which force changes in health programs. These changes affect the kinds and numbers of personnel required in the health fields.

One of the relatively newer developments in health department activities is the emphasis on mental illness and the mental health program. In this field, the shortage of personnel is more acute than in any other.

Home care, as a function of the official health agency, is a rational development in view of the tremendous problem of chronic disease. Home care is a means of economy, not only in money but also in more effective use of professional personnel.

Expansion of the use of auxiliary dental personnel likewise offers hope of more nearly meeting the needs for dental health services despite the present shortage of professional personnel in dentistry.

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# technical publications

## Announcing . . . Transcriptions of Your Mental Health Radio Series

*Public Health Service Publication No. 334. 2-fold leaflet. No sales stock.*

Beginning in March 1953, the National Broadcasting Company, in cooperation with the National Institute of Mental Health, presented a series of 13 radio programs on mental health subjects, including adolescent, marital, and old age problems, mentally retarded children, psychosomatic illness, community attitudes toward the mentally ill, and rehabilitation of the mentally ill. These programs are now available to State and local organizations for broadcast or nonbroadcast use. This leaflet outlines the content of the programs and tells how to obtain them.

## Bibliography of Occupational Health

*Public Health Bibliography Series No. 9. Public Health Service Publication No. 300. 1954. By Frances L. Hyslop and W. M. Gafafer. 110 pages. 35 cents.*

This comprehensive bibliography is the latest listing of occupational health and related publications issued by the Public Health Service from 1909 through part of 1953.

This bibliography provides a complete and continuing record for reference use. It contains voluminous information on early pioneering studies and other contributions by the Public Health Service to the detection and control of occupational diseases. At the same time, by reflecting changes in subject matter from year to year, it affords an historical perspective of shifting interests in the field of occupational health and serves as an index of progress.

There are 1,938 entries listed. The book is organized under 15 subject headings such as chemistry, dentistry, dermatology, education, and so forth, and appropriately subdivided. The items have been listed chronologically under the subject headings. There are also subject and publication indexes.

## Tuberculosis Beds in Hospitals and Sanatoria, April 1, 1953

*Public Health Service Publication No. 337. 1954. 44 pages; tables. 35 cents.*

As of April 1, 1953, there were 1,112 hospitals providing care for tuberculous patients, according to the eighth annual edition of the Index of Hospitals and Sanatoria with Tuberculosis Beds in the United States and Territories. Seven hundred and twenty-two of these hospitals provided 114,479 beds for the care of tuberculous patients. The remainder either have fewer than five tuberculosis beds, or they have no specific number of beds set aside for such patients. In the continental United States, 1,086 hospitals were providing care for tuberculous patients, 700 of which have 109,569 beds. Five hundred and seventy-eight of these 700 hospitals are non-Federal and 122 are operated by the Federal Government.

Compared with the previous edition, the number of tuberculosis beds has increased by approximately 1,700 in the continental United States, and 650 in the Territories. Five non-Federal hospitals which were under construction in 1952 contributed 632 of the increase.

Data in this publication were obtained by means of a post card questionnaire sent directly to each of about 1,000 hospitals. Approximately 95 percent of those contacted replied. Information is analyzed as to type of hospital, ownership, and control, and is compared with data in the January 1, 1952, report. The hospitals are indexed by State, with the number of beds given for each institution.

**This section carries only announcements of all new Public Health Service publications and of selected new publications on health topics prepared by other Federal Government agencies.**

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**The Public Health Service does not supply publications issued by other agencies.**

# Modified Snellen Chart For Vision Screening

By Caroline Austin, M.S.

IN MICHIGAN for many years, the most commonly used vision screening methods have been the standard Snellen symbol "E" chart and the Massachusetts vision test. Both of these methods require extensive training for the screener and in some places, because of this, there was little or no screening going on. Even the standard Snellen chart, simple as it seems to a trained eye technician, was rejected by many teachers as being too complex. It had been the feeling of the Michigan Department of Health that by providing the classroom teachers with a relatively simple, quick, and easily employed device for screening, it would be possible to find numerous children with serious eye problems who were being missed.

In an attempt to extend screening into these places where little or no screening was going on, the vision unit of the Michigan Department of Health's maternal and child health section prepared a modified symbol "E" chart based on the standard Snellen chart. The modified chart, which was first put into use in April 1952, used only the 20/30 and 20/20 symbols, placed on the new chart in 2 sections, each consisting of 2 lines of 6 symbol "E's."

The State health department did not expect the simplified chart to supplant more adequate screening methods, nor has it done so. After 2 years' experience with the new chart, the department believes that it serves the purpose for which it was intended.

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*Miss Austin, formerly a sightsaving teacher in the Illinois school system, has been supervisor of the vision unit, maternal and child health section, Michigan Department of Health, since August 1947.*

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Several years of study and experimentation preceded the actual preparation of the modified chart for general distribution. Physicians were interviewed individually and in groups to obtain their reactions to simplifying the method of using the Snellen "E" symbols. Much time and effort went into working with teachers to find their problems in using the regular Snellen test in order to overcome as many objections as possible.

The State health department determined to produce a chart that would reduce to a minimum the technical knowledge required to administer a vision screening test and the time required to give the test as well as eliminate the possibility that students might memorize the location of the symbols.

These requirements were met by producing a simple "pass-fail" screening on the 20/30 symbols and by designing the chart so that it can be hung in 4 different positions. Holes are provided for this purpose. This gives the administrators of the test 16 combinations of 6 "E" symbols from which to select at random the 3 combinations of 6 symbols needed to screen each individual's eyes, both independently and together. In giving the test no attempt is made to measure actual visual acuity.

The Michigan Department of Health is in constant touch with ophthalmologists in the State. Recommended vision screening standards are reviewed regularly by the ophthalmological committee of the Michigan Medical Society with the vision unit of the department's maternal and child health section.

The standards in the modified symbol chart were developed to conform with the ophthalmological committee's recommendations that the ability to read the 20/30 symbols with each eye independently and with both eyes together is adequate distance vision for school tasks. The ophthalmologists were aware that some children in the "20/30 or better" group have eye problems needing treatment; however, the committee advised that they not be referred to doctors since most of the children in this group do not need treatment.

It was the committee's thought that harm can be done to a screening program by referring to doctors too many children who do not require treatment. When such practice becomes common, valid referrals are too often ignored by parents. It is wiser to miss a few children, they believe, than to lose parental respect for the screening method.

The chart was also constructed so as to permit 20/20 screening if doctors desire at any time to raise referral standards for a given area or school grade. The two lines of 20/20 symbols included in the modified symbol chart also make it possible to screen for hyperopia (farsightedness). Many local health administrators had requested a test for screening for hyperopia, and acceptable standards for a referral to doctors of children with this defect had been developed when the Massachusetts vision test was first introduced in Michigan. Standards which had been accepted and which are in present use specify a +1.75-diopters correction for use until a child is 9 years old and a +1.5-diopters correction for children age 9 and over. These specifications may be changed at any time.

The new chart was sent to the National Society for the Prevention of Blindness for verification of letter size and conformity to standards for shape and contrast. With the natural aging and soiling of paper, it is difficult to produce a paper chart on which the print contrast will remain constant. This problem is somewhat reduced by asking teachers to obtain fresh charts each year and to replace them as often as necessary when they become soiled. In this way, the department attempts to prevent the charts from deteriorating to the point that they become unreliable.

### Use of the Chart

Directions for use of the chart are included with every chart distributed. The directions explain procedures for screening as simply and briefly as possible in order to reduce to a minimum the unreliability of test results produced by directions which may be either incomplete or too technical (see p. 670). They also give specifications for providing standard lighting by using two gooseneck lamps, as recommended by the National Society for the Prevention of Blindness and accepted by Michigan doctors.

No attempt has been made to replace more adequate screening methods, nor has the chart been given a great deal of publicity. Since the new chart was published, the Massachusetts vision test has continued in use in the places where it had been introduced, and it has since been adopted in many additional communities. The number of requests for the regular Snellen chart each year is increasing, and the health department has continued to print and distribute it. Requests for the new chart outnumber requests for the standard Snellen chart by 6 to 1 and have continued in that ratio since it was first introduced.

The department feels that the success of the new chart in meeting the need for obtaining more vision screening for more children is indicated by the 6 : 1 ratio along with the steady increase in the use of the other screening methods. This and the enthusiastic comments received from doctors, nurses, and teachers have convinced the department of the value of continuing to provide the modified Snellen chart for those who wish to use it.

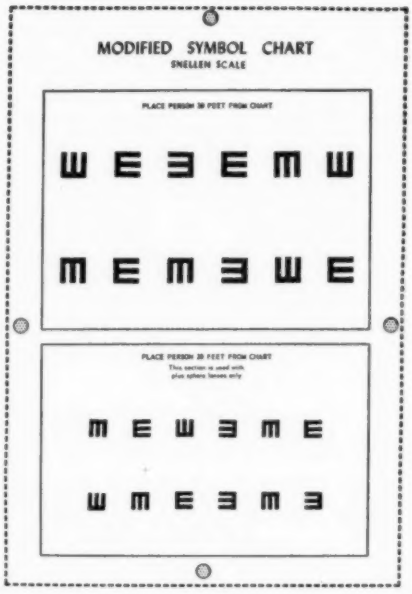
The department tries to assist parents, nurses, and teachers to understand the limitations as well as the potentialities of the screening method which they use. The vision unit, working with and through local health departments and schools, attempts to carry on an extensive educational program in order to counteract, in some measure, the effect of underreferral by improving observation and recognition of symptoms of eye difficulty.

The department feels that in all vision screening it is wise to work closely with doctors in determining acceptable methods and referral standards. Even within a small area, recommendations may vary. The department recommends that before beginning a screening program, referral standards be reviewed whenever possible by local doctors for their acceptance or their recommendations and that these referral standards be reviewed periodically to determine their continued acceptability.

## Screening Directions for the Modified Symbol Chart

The modified symbol "E" chart provides a quick yet relatively accurate means of screening for visual acuity at 20 feet. This is a screening and is in no way an eye test or examination. Hang the chart on a light-colored wall surface at eye height for the person being screened. Hang it so that no direct source of light or reflected glare is within the field of vision as the child looks toward the chart from 20 feet away. Do not screen in direct sunlight or on dark, cloudy days unless you have standard lighting which may be obtained by using 2 gooseneck lamps, each having a 40-watt bulb. Measure and mark the 20-foot distance carefully. The child's eyes should be exactly 20 feet from the chart. He may sit or stand.

If children are unfamiliar with this screening method, prepare them in groups by discussing the "E" and the directions toward which the legs point. The word "test" should not be used. Ask children to tell you, instead of pointing with their fingers, which way the legs of the "E" ("table" for the very young) go. Equipment will include the following: the chart; 2 gooseneck lamps; clean eye cover of black paper for each child; white window card to isolate each symbol on the chart; measuring tape.




### Screening for Low Visual Acuity (Large Symbols)

With the child at the 20-foot mark directly in front of the chart, have him tell which way the legs point, looking first with both eyes, then with the right, and then the left. As he reads with one eye, cover the other by placing a clean black paper square diagonally across the bridge of his nose, being careful not to push on the eye itself, which should be kept open. Have the helper at the chart expose 1 symbol at a time, going straight through a group of 6 from right to left, left to right, or up, or down. Rehang the chart frequently and vary directions to avoid memorization. If the child wears glasses all of the time, test with glasses only. If glasses are worn for reading only, test without glasses. Encourage the child to do his best to read the symbols, but avoid strain. Observe his behavior during the test and record signs of strain, such as forward thrusting of the head, eyes filling with tears, excessive blinking, frowning, scowling, and so forth.

Record the number of correct responses with both eyes together, right eye, and left eye, as "Tom Jones 5–5–3." Recheck in about a week those having any score of 3 or under. Correlate all findings, including visual screening results plus observation of behavior in the classroom, general health, and eye conditions. Refer to the public health nurse or parents all children who consistently present any indications of visual disturbance and all children who, on rechecking, continue to have scores of 3 or under with both eyes together or with either eye alone. These children should have a thorough examination by a competent eye doctor.

### Screening for Farsightedness (Small Symbols)

Additional equipment is needed for giving this part of the test. Two pairs of glasses, fitting the following specifications, may usually be obtained at any good optical shop—for use with children ages 5 to 8: grinding, plus 1.75 diopters; frame size, 4½ inches; for use with children ages 9 and over: grinding, plus 1.5 diopters; frame size, 5 inches.

Advise the child that you have glasses that some boys and girls can see through and others cannot. You would like to know if he can see through them. Have him put on the pair advised for his particular age and close his eyes. After about 30 seconds, have him open his eyes and follow the same procedure as was used in the previous screening, counting the correct responses. Record the number of correct responses with both eyes together, and with each eye individually. Rescreen in about a week those having any scores of 4 or more. Those having a score of 4 or more on the recheck should be referred to a competent eye doctor.

# Effect of Fluoride In Drinking Water

## *on the osseous development of the hand and wrist in children*

By H. BERTON McCAULEY, D.D.S., and F. J. McCLURE, Ph.D.

NUMEROUS CLINICAL, as well as experimental, studies have produced evidence that detrimental effects on skeletal tissues may result from prolonged exposure to large quantities of fluorides. Roholm (*1*) described the skeletal effects of an estimated exposure amounting to 25 to 30 mg. fluorine (F) inhaled daily for 9 years or longer as follows: "The pathological process may be characterized as a diffuse osteosclerosis in which the pathological formation of bone starts both in periosteum and in endosteum; compacta densifies and thickens; the spongiosa trabeculae thicken and fuse together. The medullary cavity decreases in diameter. There is considerable new formation of bone from periosteum, and ligaments that normally do not calcify, or only advance in age, undergo a considerable degree of calcification." Exposure to cryolite dust was the cause of the bone pathology observed by Roholm, as it was of that reported by Moller and Gudjonsson (*2*).

Prolonged exposure to fluoride in quantities over 10 p.p.m. F in drinking water has been reported responsible for chronic fluorosis characterized by rigidity in the spine, stiffness, and immobility of the joints, symptoms similar to those recorded by Roholm. These effects, attributed to excessive waterborne fluoride, have been observed endemically in the Madras Presidency (*3*) and the Punjab (*4*) of India and in the Pretoria district (*5*) of South Africa. As pointed out by McClure (*6*), not only is the fluoride content of the drinking water excessive in these areas, but also the hot climate increases water consumption, and low dietary and other living standards possibly aggravate the manifestations of skeletal abnormalities.

### Exposure in the United States

In the United States, about 4.5 percent of the population is now using water which naturally contains 0.5 to 8.0 p.p.m. F. In addition, approximately 785 communities with a total population of about 15.5 million are (November 1953) using water supplies in which the

*Dr. McCauley, now director of the bureau of dental care of the Baltimore City Health Department, was engaged in research on problems related to dental health at the National Institute of Dental Research, National Institutes of Health, Public Health Service, from 1945 to 1949. Dr. McClure is chief of the Laboratory of Oral and Biological Chemistry, National Institute of Dental Research. Associated with the National Institutes of Health since 1936, Dr. McClure has done extensive research on the physiological effects of fluorine.*

fluoride level is maintained within the range 0.7 to 1.5 p.p.m. F, by controlled fluoridation, for the reduction of dental caries. In excess of 1.5 p.p.m. F in drinking water, fluoride is responsible for the production of endemic dental fluorosis, or mottled enamel, in varying degrees of severity and incidence (*7*).

A reliable basis for the point of view that concentrations of fluoride in drinking water up to 1.5 p.p.m. are not a public health hazard is the evidence pertaining to urinary excretion. When the drinking water contains as much as 4.5 p.p.m. F, excretion is more than 90 percent effective (*6*, *8*, *9*). Such a highly efficient excretion largely negates the possibility of cumulative skeletal fluorosis from continuous exposure to drinking waters containing up to 4.5 p.p.m. F.

Further evidence of the harmlessness of low-fluoride water is available in observations relating specifically to the skeletal tissues. McClure (*10*) found that exposure to fluoride waters containing up to 4.5 p.p.m. F affected neither the bone-fracture experience nor the height and weight of high school boys and young men. A skeletal survey (*11*) of children and adults living in an area of endemic mottled enamel and exposed to drinking water containing 1.5 to 3.0 p.p.m. F yielded no radiological evidence of bone abnormality. Smith (*12*) also reported no changes in calcium and phosphorus metabolism in children with mottled enamel.

Indications that the fluorine concentration of the skeletal tissues increases gradually with age were found in an analysis of the ribs and vertebras of 158 persons with continuous lifelong residence in an area of relatively fluoride-free domestic water (*13*). It is probable that the fluorine in skeletal tissues can increase several times above average quantities without causing a deleterious skeletal effect (*6*).

In a comparison of medical histories and results of physical examinations, including complete X-rays, on adults who had lived 15 years or longer in Bartlett, Tex., where the drinking water contained 8.0 p.p.m. F, with similar information on adults living in Cameron, Tex., where the drinking water contained about 0.3 p.p.m. F, the only difference in the health status was shown by the X-rays. Among the Bartlett adults, 12 percent, all of whom were over 50 years of age and had used the Bartlett drinking water for more than 35 years, showed a somewhat coarser trabecular structure of the bones. These bone changes produced no effective signs or subjective symptoms related to the skeletal system and were regarded as having no general health significance (*14*).

The present study was organized to provide additional data on the skeletal effects of exposure to fluoride in drinking water in the United States. It was designed to determine specifically the effects of continuous exposure to drinking water containing 3.5 to 5.5 p.p.m. F on ossification and skeletal maturation as indicated by radiographs of the hand and wrist of children 7 through 14 years old.

## Radiographic Studies of Bone Development

Because it is accessible and relatively convenient to radiograph, the hand has been the subject of frequent X-ray study since Roentgen's discovery. Ranke (*15*) in 1896, using wrist films, was apparently the first to witness skeletal growth. Pryor (*16*) in 1905 reported the earliest extensive roentgen-ray observations of bone growth and development in the hand.

Pryor (*16*,*17*) studied more than 500 films of children from birth to 14 years of age and found a definite and uniform order of ossification of the carpal bones. Although the centers of calcification practically always appeared in the same order, the progress of ossification was subject to delay by ill health, metabolic disorder, interference with blood supply, accident, or disease. He discovered also that the skeleton of the growing girl is more mature than that of the boy of the same age and that the hand is a good index of ossification of the entire skeleton (*18*).

### *Skeletal Age*

Comprehensive investigations by Flory (*19*), Todd (*20*), Greulich (*21*), and others have, in general, confirmed and amplified the observations of the early investigators and provided standards for the practical assessment of skeletal age by radiographic inspection of the hand. Ample evidence that the progress of

development of the bones of the hand and wrist parallels that of the rest of the skeleton is provided in these and numerous other reports of the chronology of appearance and fusion of centers of ossification throughout the body. Todd (*20*) assessed skeletal maturity on the basis of X-ray findings in the hand, foot, elbow, knee, shoulder, and hip and decided that the hand was the most reliable single index.

The standards used to assess skeletal age in the present study are the composite record of skeletal development of Cleveland children from all grades of society, except the destitute, without regard to ethnic origin, stature, or weight (*20*). They represent large numbers of children radiographed at 6-month age intervals from birth through the 18th year and have been widely utilized in overall growth studies.

### *Ossification Index*

Use of skeletal age in attempts to grade children for educational purposes caused investigators to seek a procedure for determining developmental status more objective than the inspectional technique. Baldwin (*22*) in 1921 was the first to report measurement of the carpal bones for this purpose, using a planimeter to ascertain the total area of their shadows on the X-ray picture. Later, Baldwin, Busby, and Garside (*23*) published a series of such measurements for school-age children, corrected for gross size by dividing the ossified area by the area of a rectangle of dimensions derived from two diameters of the wrist obtained with calipers. Similar quantitative indexes and norms of skeletal development were produced by Carter (*24*) and Kelly (*25*). The Carter (*24*) method, used in the present study, has been applied successfully in general growth (*19*) and nutritional (*26*, *27*) problems in children.

## Study Areas

Amarillo and Lubbock, in western Texas, were selected for this study because they are the two largest communities in the United States having 3.5 p.p.m. F or more in their public water supplies. The populations are 74,000 and 71,000, respectively.

The fluoride content of the drinking water in Amarillo, according to frequent analyses by the city chemist, ranged from 3.6 p.p.m. F to 6.2 p.p.m. F during the period 1934 through 1948. The study was made in 1948. Monthly analyses by Elvove (*28*) in 1933 and 1934 averaged 3.9 p.p.m. F. In 1948, McClure found 3.3 p.p.m. F in a single sample of water. The water supply in Lubbock has been more constant in fluoride content. In 1933 and 1934, it averaged 4.4 p.p.m. F (*28*); in 1943, 3.8 p.p.m. F (*8*); and in 1948, 3.5 p.p.m. F. The epidemiological data on the distribution of mottled enamel in these two communities reported by Dean (*7*) are in agreement with these analyses (see table 1).

Water supplies in the Texas Panhandle generally contain from 2.0 to 5.0 p.p.m. F (*7*). Anyone living in Amarillo or Lubbock or in their wide environs would be exposed to fluoride drinking water.

Cumberland, in western Maryland, was selected as the control city. Its population is 37,000, and its water supply is obtained by impounding surface water flowing in a nearby mountain stream. At the time of the study, the water contained 0.12 p.p.m. F. This low level of waterborne fluoride produces no mottled enamel in the Cumberland population.

**Table 1. Percentages of school children in Amarillo and Lubbock, Tex., affected by mottled enamel** [1]

| Community | Signs absent | | White opaque spots | | Brown stains and pitting | |
|---|---|---|---|---|---|---|
| | Normal | Questionable | Very mild | Mild | Moderate | Severe |
| Amarillo, Tex | 3. 1 | 6. 6 | 15. 2 | 28. 0 | 33. 9 | 13. 2 |
| Lubbock, Tex | 1. 1 | 1. 1 | 12. 2 | 21. 7 | 46. 0 | 17. 9 |

[1] Data from reference 7.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## Study Procedures

Children selected for radiography had histories of continuous residence in the communities and continuous consumption of the local drinking water. This information was obtained by means of a questionnaire completed and signed by parents. No child with a history of absence from his community for more than 6 months at one time was included in the survey. Children aged 7 through 14 years were selected because they were accessible in the public schools and because this age span covers a period of rapid calcification and growth of the bones of the hand and wrist.

### *Mottled Enamel Diagnosis*

While the children of Amarillo and Lubbock were at hand for their X-ray photographs, their teeth were inspected for mottled enamel. A record was made of the degree of mottling observed, using a simple comparative score of none, mild, moderate, or severe. The presence of moderate or severe mottled enamel is evidence of continuous exposure to fluoride drinking water during the period of tooth formation. Mild mottling or the absence of mottling may be attributed to reduced susceptibility to fluorine or to a reduced consumption of the local water supply during formative tooth life.

### *Radiographs*

An X-ray picture showing the right hand and wrist of each child in the study was made in the school using portable equipment and a standard technique (*19*). This radiograph was produced on 5-inch x 7-inch no-screen film in a cardboard holder with 10 milliampere-seconds exposure, 70 peak kilovolts output, and 32-inch target-film distance. It was identified by a serial number applied with lead numerals on exposure, corresponding to the number assigned to the questionnaire returned by the child's parent. For densitometric purposes, an ivory step tablet was included in each exposure. Most of the films were developed in the field, usually on the day they were exposed. Radiographs of 2,050 children—965 boys and 1,085 girls—were used in the study. Distribution of the children by age and community of continuous residence is given in table 2.

### *Ossification Index*

The films were used to establish a quantitative index of skeletal development for each child, employing the technique of Carter (*24*). According to this method, the areas of the shadows of the eight carpal bones and of the radial and ulnar epiphyses are measured with a polar planimeter. Their sum, the total ossified area, is divided by the area of a quadrilateral anatomically described for each film. The quotient is the ossification ratio. This ratio is an index of carpal ossification of the child, subject of the radiograph, corrected for his size, and therefore comparable to like indexes derived for other children. It reflects the status of development of the skeleton as a whole and may be correlated with chronological age in normally growing children.

In a test of reliability, the ossification ratio was determined from each of 50 radiographs by McCauley. Later, without the knowledge of

**Table 2. Distribution of children studied, by age, sex, and community of continuous residence**

| Age last birthday (years) | Amarillo, Tex. | | Lubbock, Tex. | | Cumberland, Md. | |
|---|---|---|---|---|---|---|
| | Boys | Girls | Boys | Girls | Boys | Girls |
| 7 | 16 | 27 | 32 | 38 | 41 | 40 |
| 8 | 44 | 56 | 46 | 44 | 48 | 46 |
| 9 | 45 | 64 | 47 | 48 | 48 | 60 |
| 10 | 29 | 46 | 37 | 51 | 54 | 63 |
| 11 | 37 | 27 | 42 | 30 | 62 | 44 |
| 12 | 39 | 34 | 43 | 52 | 47 | 51 |
| 13 | 36 | 39 | 47 | 56 | 32 | 47 |
| 14 | 21 | 31 | 36 | 41 | 36 | 50 |
| All ages | 267 | 324 | 330 | 360 | 368 | 401 |

indexes previously obtained, a laboratory assistant repeated the planimetry and calculation of the ossification ratio from the same films. The second determinations were correlated with the first by coefficient 0.975. This index was similarly reliable in the hands of Flory (*19*).

### *Skeletal Age Rating*

The same films were used to obtain a skeletal age rating for each child. This rating is a qualitative evaluation of osseous development arrived at by comparison of the child's radiograph with a series of radiographs of the hand representing standards of maturation at varying levels of chronological age. Individual films, and therefore children, were assigned a developmental age.

For purposes of this study, skeletal age was determined by observation of (*a*) the contours of the metacarpal and phalangeal epiphyses, (*b*) the progress of their union with the diaphyses, (*c*) the presence or absence of each of the eight carpal bones and of the distal epiphyses of the radius and ulna, and (*d*) their morphology and stage of diaphyseal union. The assigned rating was that of the standard radiograph in which the above determinants of maturity most nearly approached those observed in the film being rated. This method, described originally by Todd (*20*) and more recently by Greulich and Pyle (*21*), supplements the quantitative method of Carter and offers a convenient control.

The standard radiographs used in the present study were obtained from the Brush Foundation. They were selected by Todd and his coworkers from radiographs of Cleveland children included in their extensive investigations at the Western Reserve University. Two series were employed, one for boys and another for girls. In the ages 7 through 14, each series contained a standard of osseous development in the hand at 6-month intervals. Similar standards are available in the publications of Flory (*19*), Todd (*20*) and Greulich (*21*).

All assessments of skeletal age were made by McCauley. However, to test the reliability of the method, 67 radiographs each received an additional independent rating by one or another of three fellow laboratory workers. The duplicate ratings were correlated with the original by the coefficient 0.906. Flory (*19*) reported skeletal age ratings 87 to 97 percent reliable, depending on the training of the worker and the care with which the determinations are made. Todd (*20*) found that assessment of skeletal maturity from the hand was accurate to 6 months and associated with a reliability coefficient of 0.9.

### *Age Groupings*

To provide the maximum numerical base for determining mean age-specific ossification indexes and skeletal age ratings, the films of all the children in the study were separated by sex, then listed in the order of age at the time the radiographs were exposed. The radiographs were then divided into seven overlapping yearly age groups with average ages 96, 108, 120, 132, 144, 156, and 168 months, or 8 through 14 years. Each group consisted of children whose ages did not differ from the group average by more than 6 months. For instance, a group appearing in the tables of this report as having an average chronological age of 96 months (8 years) is composed of children 7 and 8 years old on their last birthday, consistent with the 96-month mean. Similarly, the group of average age 108 months (9 years) includes children 8 and 9 years old, and the group of average age 10 consists of 9- and 10-year olds.

## Results

Mean carpal ossification indexes and skeletal age ratings, together with their standard errors, for boys and girls in the age groups described above are given in tables 3 and 4. Excluding standard errors, these data are presented graphically in figures 1 through 4. Weighted mean ossification indexes and skeletal age ratings for the groups combined for all ages and for mottled enamel experience are presented in figure 5. These tables and graphs also include data obtained by Flory (*19*) for University of Chicago normal children which are suitable for comparison with the data from this study. Uniformity of the data for individual children and among the groups is apparent in the standard errors of means of the

**Table 3. Mean ossification ratios, and their standard errors, of carpal bones of normal children and of children exposed and not exposed to high-fluoride waters**

| Average chronological age (months) | Fluoride water (3.5–4.5 p.p.m. F) Lubbock, Tex. | | Fluoride water (3.3–6.2 p.p.m. F) Amarillo, Tex. | | Mottled enamel, moderate or severe, Lubbock and Amarillo, Tex. | |
|---|---|---|---|---|---|---|
| | Number of children | Mean ossification ratio | Number of children | Mean ossification ratio | Number of children | Mean ossification ratio |
| *Boys* | | | | | | |
| 96 | 69 | 46. 62±1. 08 | 42 | 48. 94±1. 71 | 53 | 49. 29±1. 39 |
| 108 | 93 | 53. 24±1. 07 | 89 | 55. 87±1. 19 | 116 | 55. 11±0. 99 |
| 120 | 79 | 60. 34±1. 11 | 62 | 61. 73±1. 08 | 111 | 61. 05±0. 89 |
| 132 | 79 | 68. 73±1. 18 | 66 | 70. 69±1. 52 | 110 | 69. 03±0. 95 |
| 144 | 85 | 77. 54±1. 38 | 75 | 79. 51±1. 31 | 122 | 77. 78±1. 07 |
| 156 | 90 | 85. 22±1. 42 | 69 | 89. 13±1. 40 | 118 | 86. 68±1. 17 |
| 168 | 70 | 94. 42±1. 30 | 38 | 99. 29±1. 60 | 87 | 94. 87±1. 23 |
| *Girls* | | | | | | |
| 96 | 75 | 58. 55±1. 21 | 61 | 61. 24±1. 28 | 67 | 60. 58±1. 32 |
| 108 | 90 | 66. 65±1. 26 | 120 | 71. 16±1. 12 | 130 | 69. 41±1. 05 |
| 120 | 99 | 76. 27±1. 17 | 94 | 82. 00±1. 28 | 133 | 79. 02±1. 03 |
| 132 | 63 | 86. 29±1. 42 | 59 | 92. 59±1. 48 | 92 | 89. 42±1. 31 |
| 144 | 78 | 95. 22±1. 02 | 57 | 99. 85±1. 05 | 90 | 97. 36±0. 90 |
| 156 | 108 | 101. 91±0. 80 | 72 | 104. 27±0. 80 | 135 | 103. 25±0. 65 |
| 168 | 86 | 107. 04±0. 61 | 56 | 109. 13±0. 92 | 99 | 107. 95±0. 59 |

| Average chronological age (months) | Mottled enamel, zero or mild, Lubbock and Amarillo, Tex. | | Nonfluoride water, no mottled enamel, Cumberland, Md. | | University of Chicago normal children | |
|---|---|---|---|---|---|---|
| | Number of children | Mean ossification ratio | Number of children | Mean ossification ratio | Number of children | Mean ossification ratio |
| *Boys* | | | | | | |
| 96 | 33 | 45. 71±2. 02 | 81 | 47. 79±1. 13 | 100 | 52. 46±0. 90 |
| 108 | 54 | 52. 41±1. 54 | 96 | 54. 99±1. 19 | 100 | 60. 12±0. 86 |
| 120 | 25 | 61. 24±2. 02 | 99 | 61. 79±1. 14 | 100 | 68. 89±0. 96 |
| 132 | 27 | 70. 50±2. 47 | 116 | 69. 38±1. 09 | 100 | 75. 82±0. 99 |
| 144 | 33 | 80. 86±2. 31 | 99 | 80. 93±1. 20 | 100 | 84. 57±1. 01 |
| 156 | 33 | 91. 25±1. 80 | 67 | 89. 73±1. 61 | 100 | 95. 43±0. 87 |
| 168 | 23 | 99. 33±2. 23 | 67 | 98. 79±1. 31 | 100 | 101. 17±0. 77 |
| *Girls* | | | | | | |
| 96 | 56 | 60. 41±1. 50 | 80 | 62. 17±1. 17 | 100 | 65. 34±0. 90 |
| 108 | 59 | 69. 10±1. 81 | 103 | 71. 27±1. 17 | 100 | 75. 73±0. 99 |
| 120 | 48 | 80. 55±1. 88 | 123 | 81. 89±1. 05 | 100 | 84. 58±0. 92 |
| 132 | 30 | 89. 30±1. 88 | 93 | 91. 76±1. 27 | 100 | 93. 48±0. 80 |
| 144 | 28 | 95. 96±1. 67 | 95 | 100. 66±0. 96 | 100 | 101. 30±0. 76 |
| 156 | 44 | 101. 72±1. 28 | 97 | 106. 03±0. 63 | 100 | 105. 27±0. 64 |
| 168 | 42 | 107. 62±1. 06 | 97 | 109. 71±0. 69 | 100 | 108. 34±0. 58 |

data for each age group. Relatively large numbers of individuals are included in each age group. In general, the results appear satisfactory for reasonably sound conclusions.

The ossification ratios for boys of Amarillo, Lubbock, and Cumberland are uniform throughout, with the exception of those for Lubbock boys aged 13 and 14 years, which indicate a somewhat retarded rate of calcification (table 3, fig. 1). The data for boys in all three cities, however, indicate a bone development less rapid than for the University of Chicago normal children. The data for girls indicate a consistently lower rate of calcification for Lubbock girls than for any other group of girls. The other groups of girls, including the Uni-

**Table 4. Mean skeletal age ratings, and their standard errors, of carpal bones of normal children and of children exposed and not exposed to high-fluoride waters**

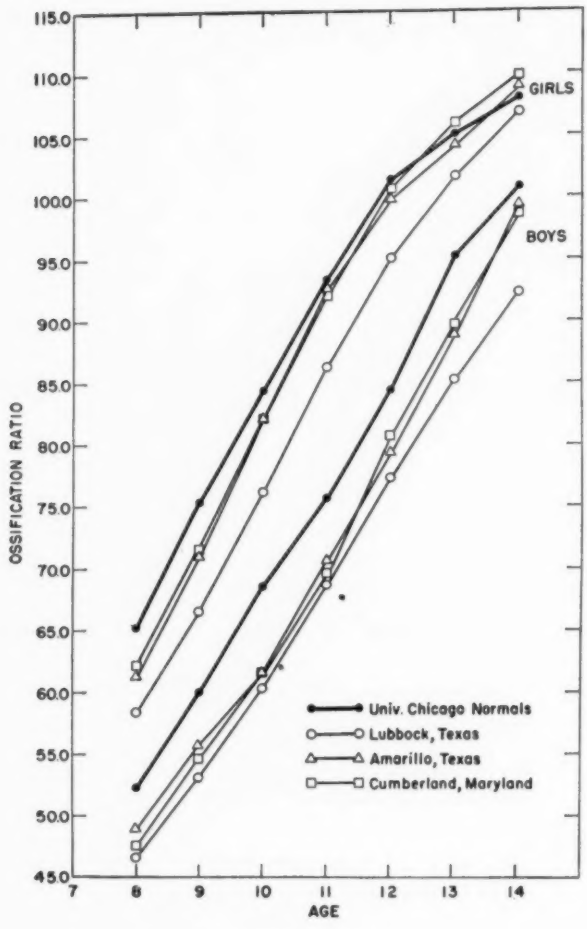
| Average chronological age (months) | Fluoride water (3.5–4.5 p.p.m. F) Lubbock, Tex. | | Fluoride water (3.3–6.2 p.p.m. F) Amarillo, Tex. | | Mottled enamel, moderate or severe, Lubbock and Amarillo, Tex. | |
|---|---|---|---|---|---|---|
| | Number of children | Mean skeletal age rating (months) | Number of children | Mean skeletal age rating (months) | Number of children | Mean skeletal age rating (months) |
| *Boys* | | | | | | |
| 96 | 69 | 85. 35±1. 37 | 42 | 88. 29±2. 09 | 53 | 89. 04±1. 62 |
| 108 | 93 | 96. 94±1. 11 | 89 | 99. 20±1. 75 | 116 | 99. 21±1. 46 |
| 120 | 79 | 111. 00±1. 87 | 62 | 109. 94±1. 76 | 111 | 110. 30±1. 50 |
| 132 | 79 | 126. 72±1. 74 | 66 | 125. 09±2. 14 | 110 | 125. 62±1. 53 |
| 144 | 85 | 140. 29±1. 48 | 75 | 138. 20±1. 51 | 122 | 138. 84±1. 20 |
| 156 | 90 | 150. 73±1. 64 | 69 | 151. 00±1. 70 | 118 | 150. 61±1. 46 |
| 168 | 70 | 163. 71±1. 72 | 38 | 165. 79±2. 52 | 87 | 163. 34±1. 72 |
| *Girls* | | | | | | |
| 96 | 75 | 89. 00±1. 29 | 61 | 90. 05±1. 20 | 67 | 90. 04±1. 22 |
| 108 | 90 | 97. 60±1. 24 | 120 | 99. 80±1. 11 | 130 | 99. 09±1. 07 |
| 120 | 99 | 108. 58±1. 36 | 94 | 113. 68±1. 51 | 133 | 110. 82±1. 22 |
| 132 | 63 | 124. 43±1. 93 | 59 | 129. 81±2. 04 | 92 | 126. 72±1. 68 |
| 144 | 78 | 142. 54±1. 55 | 57 | 145. 11±1. 91 | 90 | 143. 60±1. 45 |
| 156 | 108 | 157. 17±1. 39 | 72 | 158. 67±1. 41 | 135 | 157. 44±1. 14 |
| 168 | 86 | 170. 23±1. 27 | 56 | 175. 07±2. 04 | 99 | 171. 57±1. 30 |

| Average chronological age (months) | Mottled enamel, zero or mild, Lubbock and Amarillo, Tex. | | Nonfluoride water, no mottled enamel, Cumberland, Md. | | University of Chicago normal children | |
|---|---|---|---|---|---|---|
| | Number of children | Mean skeletal age rating (months) | Number of children | Mean skeletal age rating (months) | Number of children | Mean skeletal age rating (months) |
| *Boys* | | | | | | |
| 96 | 33 | 81. 91±2. 45 | 81 | 87. 22±1. 54 | 50 | 96. 7±0. 88 |
| 108 | 54 | 94. 78±2. 15 | 96 | 99. 19±1. 64 | 50 | 105. 2±1. 23 |
| 120 | 25 | 106. 56±3. 11 | 99 | 111. 42±1. 71 | 50 | 117. 5±1. 13 |
| 132 | 27 | 126. 33±3. 40 | 116 | 123. 76±1. 67 | 50 | 128. 4±1. 17 |
| 144 | 33 | 140. 64±2. 51 | 99 | 141. 48±1. 37 | 50 | 140. 8±0. 84 |
| 156 | 33 | 153. 55±1. 88 | 67 | 152. 55±1. 96 | 50 | 152. 8±0. 94 |
| 168 | 23 | 167. 35±3. 04 | 67 | 164. 46±1. 67 | 50 | 167. 4±1. 25 |
| *Girls* | | | | | | |
| 96 | 56 | 89. 57±1. 39 | 80 | 90. 98±1. 12 | 50 | 95. 8±1. 26 |
| 108 | 59 | 98. 28±1. 64 | 103 | 101. 85±1. 10 | 50 | 108. 2±0. 99 |
| 120 | 48 | 112. 50±1. 97 | 123 | 113. 15±1. 19 | 50 | 119. 9±0. 94 |
| 132 | 30 | 126. 60±2. 75 | 93 | 127. 71±1. 79 | 50 | 133. 0±1. 07 |
| 144 | 28 | 144. 85±2. 39 | 95 | 144. 60±1. 55 | 50 | 145. 8±1. 28 |
| 156 | 44 | 158. 32±2. 11 | 97 | 159. 00±1. 18 | 50 | 158. 0±1. 30 |
| 168 | 42 | 173. 00±2. 27 | 97 | 170. 38±1. 42 | 50 | 170. 5±1. 00 |

versity of Chicago normal children, are quite uniform throughout, as shown in figure 1. The data showing ossification ratios of children classified according to the mottled enamel diagnosis indicate uniformity for all ages and for boys and girls in all groups (table 3, fig. 2).

In figure 5, the mean carpal ossification ratios for boys and girls of all ages are compared graphically. The Lubbock boys and girls had the lowest values, and the value for Lubbock boys corresponds to that for boys of both Amarillo and Lubbock who showed little or no mottled enamel. The girls in Lubbock and Amarillo who had moderate or severe mottled enamel compared favorably with both the Cumberland and the University of Chicago girls and with

**Figure 1. Mean ossification ratios of carpal bones.**




the girls in Lubbock and Amarillo diagnosed as having only mild or no mottled enamel.

*Skeletal Age Ratings*

For ages 8 through 11 years, the skeletal age ratings for the children in Lubbock, Amarillo, and Cumberland differ from the ratings for the University of Chicago children (table 4, fig. 3). However, at ages 12, 13, and 14 years, all groups agreed remarkably well. When the children were classified according to mottled enamel diagnosis, all groups demonstrated uniformity in skeletal age ratings (table 4, fig. 4).

As shown in figure 5, the data for mean skeletal age ratings suggest some advanced development for Lubbock girls and perhaps for both boys and girls of Amarillo and Lubbock who had moderate or severe mottled enamel. This finding was not apparent, however, when the Amarillo boys and girls were considered as a group regardless of the mottled enamel diagnosis.

*Sex Differences*

The repeated observations of advanced skeletal maturity in girls, as compared with boys, from birth through the growing years is confirmed in the findings in this study. Sex differences in skeletal development are particularly evident in comparisons of the ossification ratios (tables 3 and 4, figs. 1, 2, and 5). They are suppressed in comparisons of skeletal age ratings because of the use of separate standards for boys and girls (figs. 3, 4, and 5). Between ages 7 and 12 years, average osseous development in the girls apparently proceeded approximately at the same rate as in boys, as shown by the slope of the curves, but was advanced about 2 years over that of the boys. This lead was reduced in the next 2 years as the girls

**Figure 2. Mean ossification ratios of carpal bones.**

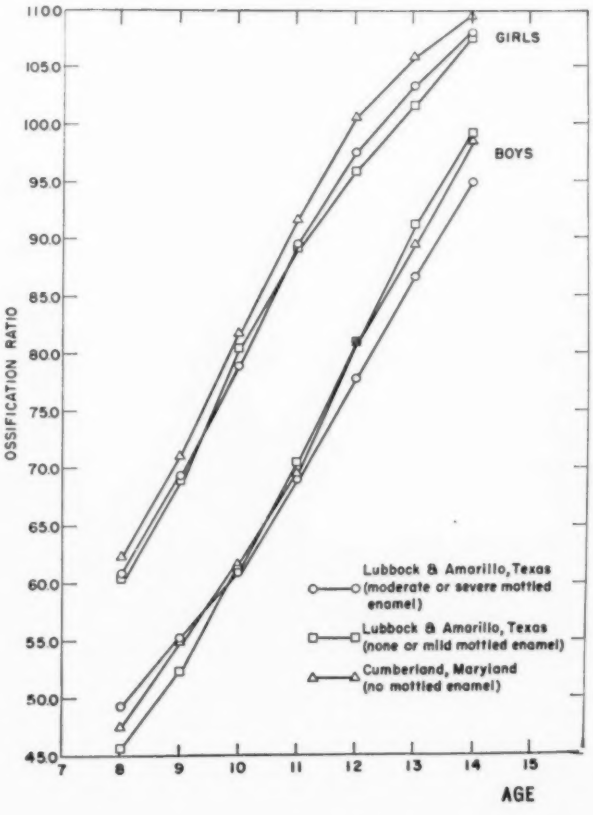
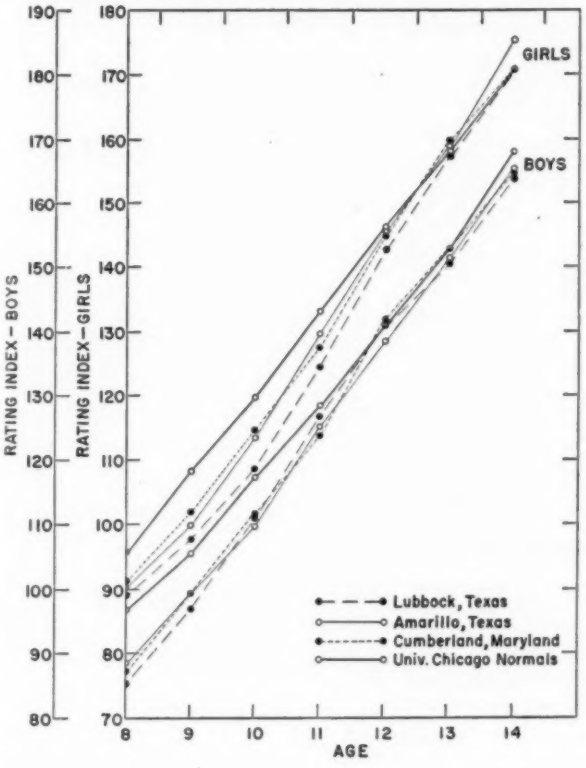


**Figure 3. Skeletal age rating index as determined by carpal bone calcification.**




approached maturity and the boys continued to grow at the same rate as before.

## Discussion

Continuous exposure to relatively high levels of waterborne fluoride apparently failed to influence the calcification of the carpal bones of children aged 7 through 14 years. This result appears evident in the high order of agreement in the data obtained on three location groups of children, with and without exposure to waterborne fluoride.

Minor differences occurred in the weighted mean carpal ossification ratios and in the mean skeletal age ratings for the University of Chicago, Amarillo, Lubbock, and Cumberland children, but these differences appear not to be associated with the exposure to high-fluoride water received by the Amarillo and Lubbock children. The data suggest some tendency toward a uniformly lower osseous development among Lubbock children, particularly girls, but not among Amarillo girls or boys. However, since children in both communities were exposed to fluoride waters, this suggested difference may be related to other factors.

It has been reported that the progress of ossification may be influenced by environmental conditions (*29*, *30*), extremes in climate (*31*), systemic disorders (*30*, *32*), and endocrine functions (*32*). Lubbock and Amarillo are within 150 miles of each other, but they differ somewhat in environmental surroundings. Lubbock is a relatively new community, the seat of a large technologic college, and the center of an agricultural area. Amarillo is a much older town and is surrounded by cattle ranges. The populations in the two communities may therefore differ somewhat in their hereditary and ethnic background and in general day-to-day activities. The effects of environmental variables on bone development among the children of these towns, however, are purely speculative.

As previously mentioned, the most pronounced nondental effect of excessive quantities of fluorine is an advanced calcification in both skeletal and ligamentous tissues (*1–4*). Experimental studies with animals have also given

**Figure 4. Skeletal age rating index as determined by carpal bone calcification.**

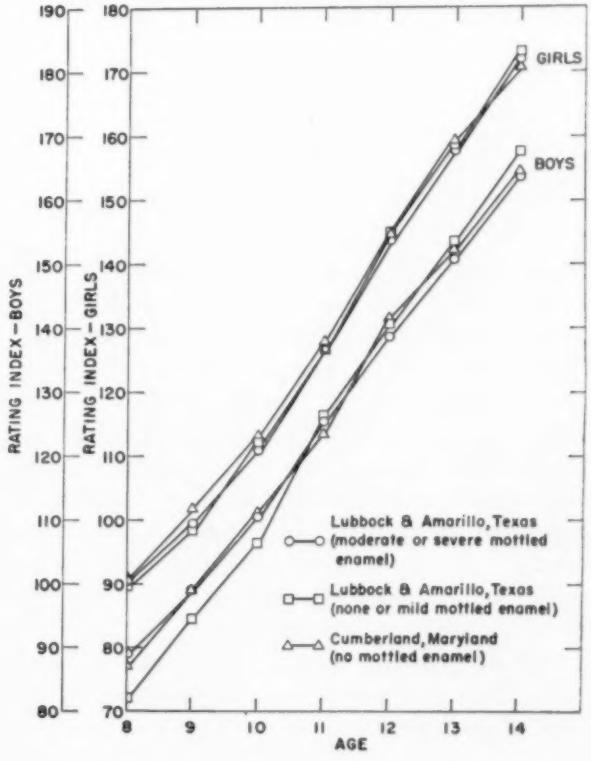
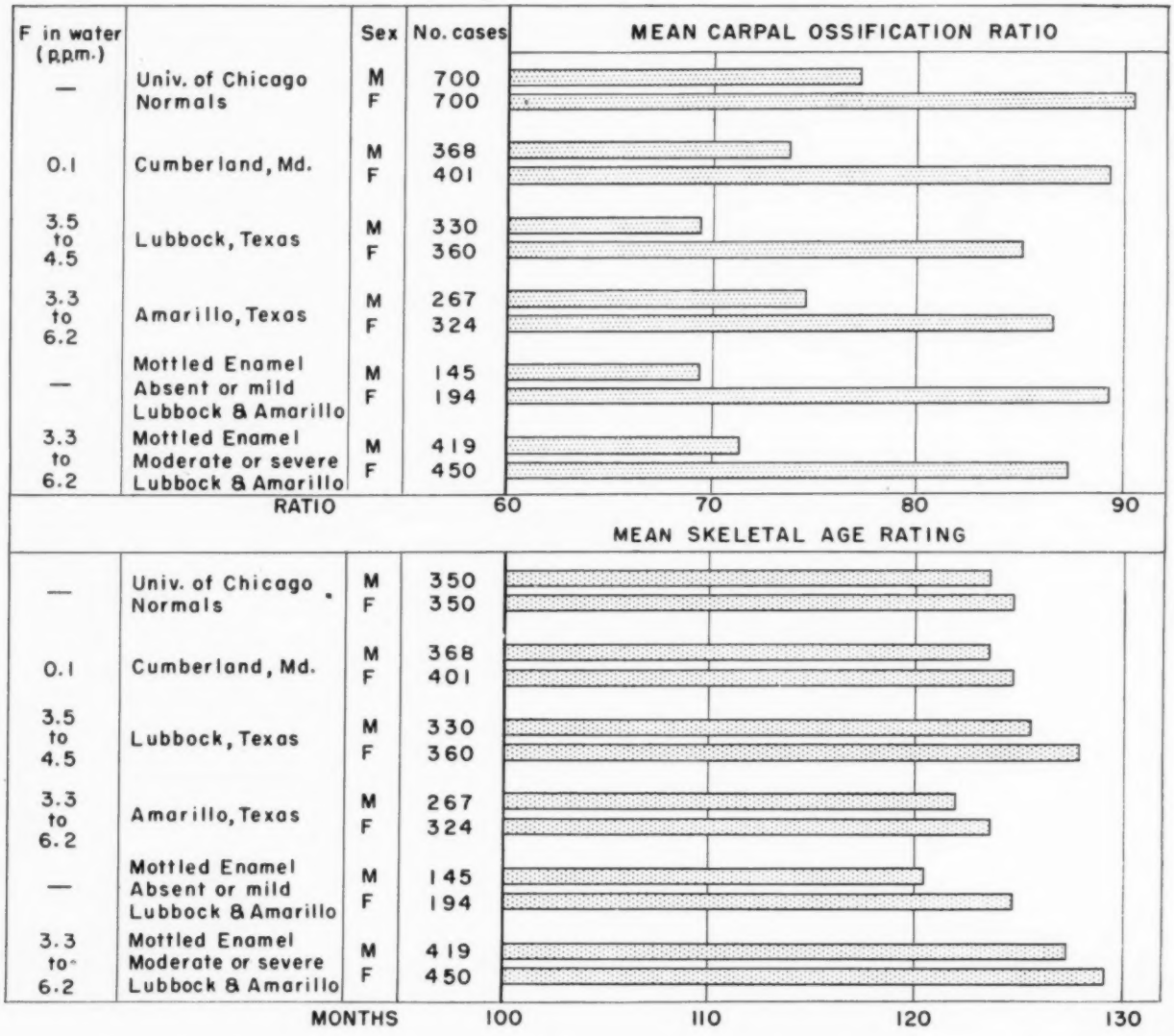


**Figure 5. Mean carpal ossification ratios and skeletal age ratings for groups of children with and without exposure to high-fluoride waters.**




evidence that a high-fluorine intake is identified with skeletal hypercalcification (*33–36*). Results in these latter studies are based generally on analytical data. Inconsistencies in the data are attributed mainly to variations in calcium intake as well as to the extent and duration of the fluoride exposure. In general, relatively excessive quantities of fluoride must be ingested by experimental animals to produce calcification changes, as shown by ash, calcium, or phosphorus analyses. For example, in a recent report (*36*), as much as 50 p.p.m. F in the drinking water of growing experimental rats caused a more than fivefold increase in the fluorine content of mandibles and femurs without affecting the amount of ash, calcium, or phosphorus or the calcium : phosphorus ratio of the ash. More recent attempts to assess the relation of fluorine to calcium metabolism of skeletal tissues have made use of $Ca^{45}$ (*37*, *38*). These studies have failed to produce evidence of any pronounced effect of relatively high levels of fluorine on the calcium metabolism of skeletal tissues.

A survey of the previous experiences with fluorine, both clinically and experimentally, in respect to skeletal tissue development, therefore, gives every reason to expect that if any effects were to be found in the present study of the development of the carpal bone in children, they would be in the nature of hypercal-

cification and advanced skeletal maturity and bone development. The calcification data accumulated in this study do not indicate the occurrence of this characteristic skeletal effect of fluorine among the children drinking the fluoride waters of Lubbock and Amarillo. Apparently, approximate levels of 3.5 to 5.0 p.p.m. F in the drinking water are not sufficient to affect calcification in skeletal tissues which are developing at ages 7 through 14 years. The presence of 3.5 to 5.0 p.p.m. F in the drinking water also has not altered the long-established sex differences in the rate of development.

Previously in this report, evidence was cited which showed that the development of bones of the hand and wrist parallels that of the rest of the skeleton. On the basis of this evidence, it seems justified to suggest that skeletal development throughout the body was not affected by the exposure to high-fluoride water received by the Lubbock and Amarillo children. There may be some consistency in this finding and previous evidence that age, height, and weight relations and bone-fracture experience are not influenced by exposure to high-fluoride waters (*10*). A number of the persons included in the previous study lived in Amarillo and Lubbock or their immediate environs.

The results of this study apply to the continuous exposure to drinking water containing approximately 3.5 to 6.2 p.p.m. F, quantities considerably larger than the approximately 1.00 p.p.m. F added to drinking water for the partial control of dental caries. There is every justification for concluding from these results, therefore, that this added 1.00 p.p.m. will not be detrimental to the skeletal development of children as shown by the progress of calcification in the carpal bones.

## Summary

Exposure to fluoride in drinking water was studied for evidence of detrimental effects on skeletal calcification and bone development in children. Three groups of children aged 7 through 14 years, living in Lubbock and Amarillo, Tex., and Cumberland, Md., were selected on the basis of continuous exposure to their communal drinking waters, which contained fluoride in the amounts of 3.5 to 4.5 p.p.m. F, 3.3 to 6.2 p.p.m. F, and 0.1 p.p.m. F, respectively. Radiographs were taken of the right hand and wrist of 2,050 children. From these X-rays, the skeletal age was assessed and a quantitative index of ossification was determined.

No evidence, available by radiographs, was obtained which would indicate that there was any adverse effect on the carpal bones or on their growth and development as a consequence of the continuous use of drinking water containing approximately 3.5 to 6.2 p.p.m. F. These results confirm the safety of maintaining the fluoride level of public water supplies at about 1.00 p.p.m. F, by controlled fluoridation, for the reduction of tooth decay.

## ACKNOWLEDGMENTS

Acknowledgment is made to the staffs of the public schools in Amarillo and Lubbock, Tex., and Cumberland, Md., for their cooperation and assistance in taking the X-ray pictures; J. W. Wyatt, city chemist of Amarillo, for providing data on fluorine content of the water; and Saint Anthony's Hospital in Amarillo, Doctors Hospital in Lubbock, and Allegheny Hospital in Cumberland, for use of their darkrooms to develop the films.

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# Untreated Syphilis in the Male Negro

## —*A Prospective Study of the Effect on Life Expectancy*—

By J. K. SHAFER, M.D., LIDA J. USILTON, Sc.D., and GERALDINE A. GLEESON, A.B.

DETERMINATION of the quantitative effect of a disease on life expectancy has posed numerous difficulties, both statistical and medical. This is more apparent in chronic disease than in acute disease where determination of death or survival is, relatively speaking, revealed without delay.

In discussion of chronic disease, with limited funds available for public health activities, the determination of which diseases shall be made the target of concerted effort often is based on the economic effects of disease, that is, the economic effects as they relate to the need for hospitalization or care of the individual out of public moneys. Certainly more concern should be given to the fact that life has value, happiness, and dignity which are greater in health than in disease.

The problems inherent in answering quantitative questions relating to the lethal effects of chronic disease have been reviewed repeatedly (*1–3*). They will not be discussed here other than to state that one of the chief obstacles in such determinations is that data have to be secured on the basis of retrospective rather than prospective bases.

*Dr. Shafer, assistant chief, Division of Personnel of the Public Health Service, was formerly chief of the Venereal Disease Program, Division of Special Health Services, Bureau of State Services. Miss Usilton is public health administrator and Mrs. Gleeson is statistician with the Venereal Disease Program.* *This study of untreated syphilis in the male Negro is being conducted by the Public Health Service with the cooperation of the Milbank Memorial Fund.*

### The Syphilis Problem

Syphilis is a disease with an acute span of about 2 years and with chronicity which may persist throughout the life span. Most of its lethal and crippling manifestations occur during the first 15 to 20 years of the chronic period. It has been the subject of extensive study; not only as a disease, but also in relation to the social, educational, and economic aspects of the lives of those infected with it and of the community in which it is found. The development of the structure of the present day national venereal disease control program reflects the results of this study, in spite of important areas of ignorance which still remain.

Realization of the widespread prevalence of syphilis and the related venereal diseases was responsible for the first nationwide program in public health control of venereal diseases. These diseases accounted for one of the chief causes of draft rejection in the First World War, and this fact gave impetus to establishment of the control program. The program collapsed soon after the end of the war, but over the next 15 years the ground was prepared for

epidemiological, morbidity, and mortality studies, and for determination of effective methods of diagnosis and cure. These studies were needed to provide the stimulation and justification for another attempt to control the spread of syphilis and the other venereal diseases. This program was initiated in 1938 and still is being successfully carried on.

A recent study on syphilis mortality (*4*) during the period of the Fifth Revision of the International Lists of the Causes of Death, 1939 through 1948, shows that the reduction in total syphilis mortality during the 10 years following the initiation of the control program in 1938 proceeded at a faster rate than the reduction in deaths from all causes. The number of syphilis deaths was reduced approximately 41 percent between 1939 and 1948, and the syphilis death rate was reduced about 47 percent in the same period. The progress made in reducing syphilis mortality during this 10-year period has been equivalent to the progress made against death from all causes in the 49-year period from 1900 through 1948.

In spite of the vast volume of studies on syphilis found in the medical literature of both this continent and Europe relative to all aspects of the disease, there were, in 1930, no accurate data relative to the effect of syphilis in shortening of life. Of course, the facts relative to the occurrence of central nervous system syphilis, cardiovascular syphilis, and congenital syphilis were well known from the point of view of diagnosis and pathological findings once the disease had become manifest. However, there was no accurate idea about the natural history of the disease leading up to these complications. This information was necessary in order to evaluate the effectiveness of programs of public health control with a reasonable degree of understanding of the natural history of the disease.

### The Bruusgaard Study

The findings of Bruusgaard of Norway on the results of untreated syphilis became available in 1929 (*5*). Boeck, chief of the Dermatology and Syphilology Clinic at the University of Oslo, treated 2,181 patients with early syphilis by hospitalization and simple, symptomatic remedies. He kept them under hospital care until all of the signs and symptoms of the acute, infectious stage had passed. He did not use arsenicals when they became available, nor did he use even mercury, so that his patients were allowed to run the normal course of syphilis essentially uninfluenced by therapy. By virtue of the size of the country, the centralization of records, and the workings of Norway's venereal disease control system, it was possible to secure followup data upon a large portion of this group of patients.

Bruusgaard's analysis showed the outcome of the disease in a group of 473 patients at 3 to 40 years after infection. For the first time, data were available to suggest the probability of spontaneous cure, continued latency, or serious or fatal outcome. Of the 473 patients included in Bruusgaard's study, 309 were living and examined, and 164 were dead. Among the 473 patients, 27.7 percent were clinically free from symptoms with the Wassermann negative, 14.8 percent had no clinical symptoms with the Wassermann reaction positive. On the basis of diagnoses made at examination or at autopsy, 14.0 percent had cardiovascular disease, 2.8 percent were found to have paresis, and 1.3 percent were diagnosed as having tabes dorsalis.

Bruusgaard's findings met with immediate objections, many of which were based on the validity of the basic data. Some of the questions regarding the analysis included: How accurate was the original diagnosis in many cases; how many of the cases were diagnosed and treated prior to the discovery of the dark-field microscope; was there any assurance that the course of disease in those followed was the same as in those lost from observation? (It should be noted that the Bruusgaard material recently has been subjected to an intensive review with clinical examination of most of the known survivors, and subsequent findings (*6*) will be published).

The shortcomings of Bruusgaard's work and of other retrospective studies, the most complete of which is that of Rosahn (*7*), have pointed up the need for other long-term studies. These should be planned to overcome the objections to the earlier studies and to provide answers related to the area and population groups in which the problem is concentrated.

**Table 1. Life expectancy for the nonsyphilitic individuals in the Macon County study group, and for all nonwhite males in the United States, 1950, by age group**

| Age in 1932–33 (in years) | Life expectancy in years | |
|---|---|---|
| | Nonsyphilitic individuals in Macon County study group | All nonwhite males in United States, 1950 |
| 25–29 | 41.6 | 39.7 |
| 30–34 | 38.2 | 35.5 |
| 35–39 | 34.1 | 31.5 |
| 40–44 | 29.7 | 27.5 |
| 45–49 | 25.2 | 23.8 |
| 50–54 | 20.7 | 20.5 |
| 55–59 | 16.4 | 17.6 |
| 60–64 | 12.3 | 15.2 |
| 65–69 | 8.4 | 13.3 |
| 70–74 | 4.5 | 11.1 |

### Life Table Technique Applied to Syphilis

One of the first studies in which the life table technique was used to measure the effect of syphilis in shortening of life was published in 1937 (*8*). The mortality experience of the population included in the Cooperative Clinical Studies was used as a basis for this study. It was found that the life expectancy of males with acquired syphilis is shortened from that in the general population from ages 30 to 60 by 17 percent in the white males and 30 percent in the Negro males. Any comparison of the reduced life expectancy in this study with the findings in the present study is precluded, because of disproportionate changes in the life expectancy of population groups during the 15-year interim, 1937–52.

### Background of Tuskegee Study

In the late 20's various of the foundations (Rockefeller, Rosenwald (*9*), and others) began their studies of health conditions in the south which were to eventuate in the development of local health units. One of the most striking findings in the early surveys of disease prevalence was the high rate of syphilis among the majority of the Negro groups studied. In one of the study areas (Macon County, Ala., home of Tuskegee Institute) initial efforts at control of syphilis were followed by further moves on the part of the United States Public Health Service to bring diagnosis and treatment to the population. With the finding of high preva-

**Table 2. Abridged life tables based on mortality experience of untreated syphilitic and presumably nonsyphilitic patients, Negro males 25 through 74 years of age, Macon County study group, 1933–52**

| Age interval in years | Untreated syphilitic patients | | | | | |
|---|---|---|---|---|---|---|
| | Mortality experience | | | Application to theoretical life table population | | |
| | Patient-years of observation | Number of deaths occurring | Number of deaths per 1,000 years of observation | Average number dying during interval, of 1,000 alive at beginning of interval | Number surviving at beginning of age-period, of 100,000 alive at age 25 | Life expectancy through age 74 of those individuals surviving to age-period |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| 25–29 | 305.2 | 3 | 9.8 | 12.2 | 100,000 | 34.73 |
| 30–34 | 565.0 | 9 | 15.9 | 10.4 | 94,036 | 31.78 |
| 35–39 | 724.5 | 6 | 8.3 | 10.2 | 89,203 | 28.37 |
| 40–44 | 884.5 | 7 | 7.9 | 11.7 | 84,713 | 24.75 |
| 45–49 | 832.3 | 14 | 16.8 | 15.1 | 79,846 | 21.10 |
| 50–54 | 838.2 | 23 | 27.4 | 20.6 | 73,975 | 17.57 |
| 55–59 | 763.8 | 15 | 19.6 | 28.4 | 67,203 | 14.07 |
| 60–64 | 666.0 | 24 | 36.0 | 38.7 | 58,166 | 10.86 |
| 65–69 | 442.0 | 27 | 61.1 | 51.7 | 47,727 | 7.68 |
| 70–74 | 219.8 | 14 | 63.7 | 67.6 | 36,578 | 4.25 |

lence of syphilis in the survey and with certain other factors apparent in the community it became evident that it might be possible to institute in this region a prospective—in contrast to a retrospective—study of the results of untreated syphilis in the Negro male. Such a study was needed to assist in the planning and execution of the national venereal disease control program which was then being planned for a later time.

While details of the program are available elsewhere (*10–12*), the plan may be summarized by stating that it was decided to confine the study group to males so that there would be no problem of the transmission of congenital syphilis. The study group patients were selected as having syphilis on the basis of the best serologic and clinical knowledge available at the time. A competent syphilologist spent almost a year in residence to set up the study group. The control patients were selected to provide a valid matching group from the same socioeconomic and age groups. Documentation of the validity of the control group from the socioeconomic standpoint is offered in another report (*13*).

In order to assure careful observation of the group, a Negro nurse, resident of the community and just out of training, was employed to take local responsibility for followup of all patients, both syphilitic and nonsyphilitic, under the direction of the local health officer (*14*).

Finally, in order to provide maximum validity to the findings, arrangements were made to secure autopsies on all deceased patients. Fees for autopsies and other expenses which official agencies were not able to assume were paid for by the Milbank Memorial Fund. On completion of each of the gross examinations, specimens were sent to the Pathology Division of the National Institutes of Health of the Public Health Service for microscopic study. The first report on the findings of the postmortem examinations is being prepared (*15*).

A few patients, both syphilitic and nonsyphilitic, have migrated from the area, particularly to the north, but even so, a sizable portion of those patients have been followed for examination and a few, even for autopsy. The characteristics of the group, though, have been such that most have remained where they were originally examined; both control and syphilitic groups have continued to enjoy essentially the same kind of life (*13*) and the same types of

**Table 2. Abridged life tables based on mortality experience of untreated syphilitic and presumably nonsyphilitic patients, Negro males 25 through 74 years of age, Macon County study group, 1933–52—Continued**

| Presumably nonsyphilitic patients | | | | | | Average reduction in life expectancy of those in syphilitic group | | Age interval in years |
|---|---|---|---|---|---|---|---|---|
| Mortality experience | | | Application to theoretical life table population | | | | | |
| Patient-years of observation | Number of deaths occurring | Number of deaths per 1,000 years of observation | Average number dying during interval, of 1,000 alive at beginning of interval | Number surviving at beginning of age-period, of 100,000 alive at age 25 | Life expectancy through age 74 of those individuals surviving to age-period | Number of years | Percent | |
| (1) | (2) | (3) | (4) | (5) | (6) | | | |
| 143.5 | 1 | 7.0 | 7.7 | 100,000 | 41.60 | 6.87 | 16.5 | 25–29 |
| 269.5 | 2 | 7.4 | 5.3 | 96,184 | 38.16 | 6.38 | 16.7 | 30–34 |
| 354.0 | 1 | 2.8 | 3.7 | 93,628 | 34.13 | 5.76 | 16.9 | 35–39 |
| 447.0 | 1 | 2.2 | 3.3 | 91,879 | 29.74 | 4.99 | 16.8 | 40–44 |
| 424.5 | 2 | 4.7 | 4.4 | 90,363 | 25.19 | 4.09 | 16.2 | 45–49 |
| 434.5 | 3 | 6.9 | 7.4 | 88,373 | 20.70 | 3.13 | 15.1 | 50–54 |
| 415.5 | 4 | 9.6 | 12.9 | 85,089 | 16.40 | 2.33 | 14.2 | 55–59 |
| 355.0 | 12 | 33.8 | 21.1 | 79,699 | 12.32 | 1.46 | 11.9 | 60–64 |
| 250.0 | 5 | 20.0 | 32.5 | 71,588 | 8.42 | .74 | 8.8 | 65–69 |
| 136.5 | 7 | 51.3 | 47.4 | 60,643 | 4.47 | .22 | 4.9 | 70–74 |

medical and public health care. The same nurse and pathologist-radiologist have been working with and observing the two groups since they originally were selected for study.

It is evident, then, that these patients provide an unusual group: The original selection, the physical and serologic examinations through the years, and the post-mortem studies were based upon knowledge of the desideratum to supply valid information concerning certain aspects of the chronology of a chronic disease. It has been possible to carry out the study in accordance with the original experimental design. Now, the results of the 20-year physical examination of the group and certain other aspects of the study are available to add to the interim observations (*16, 17*).

The amount of specific antisyphilitic treatment given (*18*) has been insufficient to modify significantly the course of the disease, so that comparison of the life expectancy of the two groups is a valid procedure. Furthermore, serologic study at this last examination included performance of *Treponema pallidum* immobilization (TPI) test, a laboratory procedure which indicates with a high degree of accuracy the fact of existence of syphilis in the latent stage at some time in the patient's life without regard to whether or not specific therapy has been given (*19*). Results of this test indicated a high degree of accuracy in the original diagnoses. Thus, the comparison of life expectancy can be considered to be one between two comparable groups, differing only in the presence or absence of syphilis at the time when the study was initiated.

### Statistical Method and Analysis

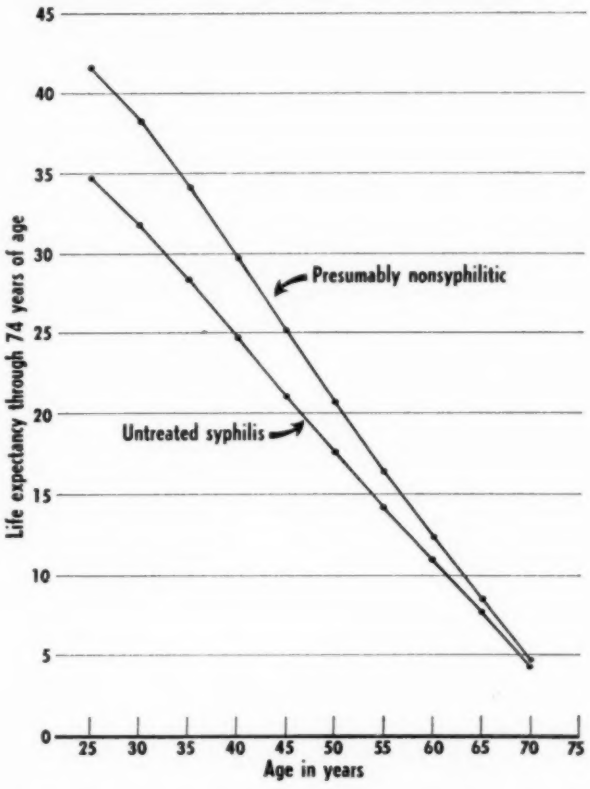
The present study group consists of 408 untreated syphilitic and 192 nonsyphilitic patients, all of whom were entered in the study during 1932–33 and who maintained their original status relative to the presence or absence of syphilitic infection. Of the syphilitic patients 165 (40.4 percent) have died and of the nonsyphilitic patients 51 (26.6 percent) have died since the beginning of the study through 1952. Approximately 60 percent of these 216 patients have been examined post mortem.

In table 1, the life expectancy of the nonsyphilitic individuals included in this study is shown in comparison to the expectancy for all nonwhite males as presented in life tables prepared by the National Office of Vital Statistics of the Public Health Service. These tables were based on the 1950 mortality experience for the entire country (*20*). The similarity of the figures within each age interval group indicates that the experience of the nonsyphilitic group in this study is sufficiently stable to serve as a measure of normal life expectancy.

The basic data used in the computation of the life expectancies of the two groups consists of (*a*) the number of deaths occurring in each group during the 20 years, 1933 through 1952, the deaths being tabulated by age interval of occurrence, and (*b*) the total number of patient-years of observation contributed by the individuals in each age group during the period under study (table 2). Age-specific mortality rates were obtained by relating the number of deaths occurring within a particular interval to the number of patient-years of observation within the interval. Due to the relatively small numbers involved, it was necessary to combine the single years into 5-year age groups for ages 25 through 74 years and to exclude the data for ages 75 years and older. From table 2, column 3, it is evident that the mortality rate for the untreated syphilitic group is higher than that for the nonsyphilitic group in each of the 5-year age intervals.

It will be noted that the rates for both the syphilitic and the nonsyphilitic groups display a general upward trend with age, as would be expected, but show the lack of stability characteristic of rates computed from small numerical values. To overcome this instability and to provide for the interpolation of rates for single years of age, necessary for the construction of the life tables, the rates for the 5-year age groups were fitted to cubic parabolas ($a+bx+cx^2+dx^3$). The resulting values are shown in column 4 of table 2. These adjusted rates were applied successively (by single years of mortality experience) to a theoretical population of 100,000 persons alive at age 25. As the mortality rates were applied, the number of survivors at each age year, 25 through 74, was

**Comparison of life expectancy through age 74 in untreated syphilitic and presumably nonsyphilitic patients surviving to specific age levels, Macon County (Ala.) study group.**




obtained by subtracting the number who would have died in the theoretical population had they been exposed to the mortality rates computed from the study groups. The number of survivors was cumulated to represent the patient-years of life at each single-year interval. At this point, the patient-years were combined into 5-year intervals to serve as base figures in the computation of the life expectancy of each 5-year age group. The figures in column 5 of table 2 represent the number of individuals surviving to the beginning of each 5-year age interval rather than the total number of individuals to which the rates were applied during the 5-year interval. The average number of years of life through age 74 remaining to individuals reaching a given age is shown in column 6 and is presented graphically in the figure.

The last two columns in table 2 represent the number of years and percentage of reduction in the life expectancy among individuals in the syphilitic group. It will be noted from the table that the difference in the average number of years of expected life for nonsyphilitic and syphilitic patients decreases gradually from the youngest age interval, 25 through 29 years, to the oldest, 70 through 74 years. This is to be expected since the effect of the natural aging processes reflected in both study groups tends to overshadow any difference due to the syphilitic process in the older age groups. Percentagewise, however, the difference in the 2 groups, syphilitic and nonsyphilitic, remains fairly constant during the first 5 age intervals, indicating that the life expectancy of a Negro male between the ages of 25 and 50 years, infected with syphilis and receiving no appreciable treatment for his infection, is reduced by about 17 percent. The 12 years (1933 through 1944) of patient observation on which the original life study (*18*) of the patients was based yielded information that the life expectancy in the syphilitic group is reduced by 20 percent among persons in the 25- to 50-year age group. It is interesting to note that the additional 8 years of mortality experience available for the present study reduced the difference in life expectancy between the study groups from 20 percent to 17 percent.

## Summary


1. The rationale for and establishment of the controlled prospective study of the effect of untreated syphilis in the male Negro are discussed.

2. The prolonged nature of a chronic disease or a disease with a chronic stage, such as syphilis, necessitates long-term study of the natural history (or pathogenesis) of the disease before the effectiveness of programs for the control of the disease can be evaluated properly.

3. Based on the mortality experience among 408 untreated syphilitic and 192 presumably nonsyphilitic patients, the general trend of mortality is higher among the syphilitic individuals between the ages of 25 and 74 years.

4. The life expectancy of an individual 25 to 50 years of age with syphilis, for which he has received no appreciable amount of therapy, is approximately 17 percent less on the average than that of an individual in the same age-interval of a nonsyphilitic population.

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*This article, and the one following, are part of a series on untreated syphilis in the male Negro which the Venereal Disease Program, Division of Special Health Services, plans to assemble into a monograph. Single copies of the monograph will be made available upon request to the Venereal Disease Program, Division of Special Health Services, Public Health Service, Washington 25, D. C.*

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# Environmental Factors in the Tuskegee Study of Untreated Syphilis

By SIDNEY OLANSKY, M.D., LLOYD SIMPSON, B.A., and STANLEY H. SCHUMAN, M.D.

THE PURPOSE of this report is to make a study of the background of the syphilitic and nonsyphilitic individuals who comprise the group considered in the study of untreated syphilis in the male Negro which has been in process in Macon County, Ala., since 1932 (*1–9*). This is familiarly referred to as the Tuskegee study.

Differences in morbidity and mortality rates have been observed in the untreated syphilitic and in the nonsyphilitic groups. It thus becomes important to determine whether factors other than presence or absence of syphilis may be operative.

Original selection of the two groups from this community to be included in the study was made on the basis of medical criteria which were related only to the presence or absence of certain specified physical and laboratory findings and personal history. The individuals making up the entire study group were selected from the positive and negative reactors found in programs of mass, communitywide serologic testing carried out in the area as part of a syphilis control program of the Public Health Service. The techniques utilized for selecting the persons to be tested were such as were thought to be equally applicable to all of the Negro members of the community without regard to their status, health or otherwise, in the community. At that time the community could be characterized as "poor." It was assumed that the only difference between the individuals selected to make the syphilitic and nonsyphilitic groups was simply the presence or absence of syphilis. This premise was stated by those who set up the study in 1932. The methods of case finding and study have as far as possible been comparable and nonselective.

However, it has been found that there are socioeconomic differences in prevalence of syphilis and that there is a relationship between socioeconomic status and morbidity and mortality.

*Dr. Olansky is director of the Public Health Service Venereal Disease Research Laboratory, Chamblee, Ga. Mr. Simpson is public health adviser, Florida State Board of Health, Jacksonville. Dr. Schuman, formerly senior assistant surgeon with the Service, and now in private practice, was an examining physician during the 1952 Tuskegee survey.*

## Syphilis Control in the Study

In 1930, the Julius Rosenwald Fund (*10*), in cooperation with the Public Health Service and State and local health authorities, conducted demonstrations of control of venereal disease in six rural counties in Alabama. Macon County, one of the counties included in this demonstration study, revealed the highest percentage of positive reactors. Macon County had a Negro population of 22,320. Of these, 3,684 received serologic tests for syphilis and, of this number, 1,466 had positive reactions (table 1). Of these reactors, 1,400 were treated; only 33 gave a history of some previous treat-

**Table 1. Results of blood test surveys of Negroes in Macon County, Ala., from which study patients were selected**

| Survey | Group tested | | Total tested | Results of serologic tests for syphilis | | | |
|---|---|---|---|---|---|---|---|
| | | | | Positive | | Negative | |
| | Sex | Age (years) | | Number | Percent | Number | Percent |
| Julius Rosenwald Fund, et al. (1930) | Both sexes | All ages | 3,684 | 1,466 | 39.8 | 2,218 | 60.2 |
| United States Public Health Service (1932) [1] | Both sexes | Over 18 | 4,400 | 990 | 22.5 | 3,410 | 77.5 |
| | Males | 25 and over | [2] 1,782 | 472 | 26.5 | 1,258 | 70.6 |

[1] From this last group, the original study patients were selected, including 399 having untreated syphilis with at least two seropositive reactions, and 201 nonsyphilitic subjects with at least two seronegative reactions.
[2] 52 (2.9 percent) unaccounted for—no data.

ment. Dr. Thomas Parran (*11*) described this county as "typifying an area of saturation with syphilis." In 1932, the Public Health Service, independent of the support of the Rosenwald Fund, started another survey in Macon County, and 4,400 Negroes, male and female, over the age of 18 years, were given tests for syphilis. From these were selected the group of patients who formed the basis of the study of untreated syphilis in the male Negro.

This present analysis of the environmental factors in the Tuskegee group is based upon study of a community which is well known both to sociologists and the Public Health Service. The members of the community know the research workers and the Public Health Service.

At the time of their selection in 1932, all the men in the study were living in or proximal to Macon County, which is 605 square miles in area and located in eastern Alabama about 40 miles east of Montgomery, the State capital. In 1932, the county was essentially agricultural, with a moderate-sized lumber industry second in importance. Its population was approximately 88 percent rural.

Macon County lies within Alabama's famous Black Belt (so known because of its rich black soil), which in former years had held Alabama in a leading position among the southern States in cotton production and export. In 1932, although cotton remained the principal agricultural crop, it was not as profitable as in previous years because of the depletion of the soil through one-crop cultivation and because of the national economic depression which affected the area severely at that time.

Formerly, many slaves had been held in Macon County to cultivate the cotton. In 1840 there were 5,369 whites and 5,878 Negroes. In the next 20 years the whites added 3,000 to their number, but the Negro slaves increased by 13,000 (table 2). After the Civil War, the large slave-holding plantations were gradually broken up into smaller tracts, and the county

**Table 2. Trend of population distribution by race in Macon County, Ala., 1840–1950**

| Year | Total population | | Negro | | White | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| 1840 | 11,247 | 100 | 5,878 | 52.3 | 5,369 | 47.7 |
| 1860 | 27,247 | 100 | 18,878 | 69.3 | 8,369 | 30.7 |
| 1930 | 27,103 | 100 | 22,320 | 82.4 | 4,783 | 17.6 |
| 1950 | 57,000 | 100 | 26,000 | 45.6 | 31,000 | 54.4 |

SOURCE OF POPULATION DATA: 1840 and 1860, Shadow of the Plantation (*12*); 1930 and 1950, Bureau of the Census population releases.

became cultivated for the most part by tenant farmers. By 1930 small farms were operated by more than 3,000 Negroes, the majority of whom were handicapped by low income, low living standards, and lack of educational opportunities. Many were waging a losing battle against economic adversity on submarginal land. Their farms represented their only source of income (*12*). The men selected for study came from this low-income group.

Coincidentally with the inception of this work with patients having untreated syphilis, another sociologic study was launched in Macon County by the Julius Rosenwald Fund. During this study 612 Negro families in the county were interviewed, and the findings were presented in Johnson's Shadow of the Plantation (*12*). In this book, life in a rural Negro community under the influence of a plantation economy is vividly portrayed, furnishing valuable source material for study of the Negro in the area during this period. From his observations, Dr. Johnson concludes: "The community studied reflects a static economy not unlike the Mexico hacienda, or the conditions of the Polish peasant, a situation in which the members of a group are 'muffled with a vast apathy.' . . . The situation is clearly one of isolation and cultural lag. The plantation communities in which Negroes live, insofar as they are areas of highest population concentration of this group, are also likely to be areas of greatest cultural isolation."

In the beginning of this study of patients with untreated syphilis, it was assumed that the group would remain in the same geographic area. Most of the study subjects were farmers and all were 25 years of age or over. They were predominantly men with families who had acquired responsibilities and had become well integrated into a community life and a folk culture which respond to change very slowly. Geographic isolation was a factor in favoring the unchanging nature of the group. In 1932, there were only 67 miles of paved highway in Macon County, most of which was U. S. Highway 80, which runs directly through the county. There were numerous unimproved roads which were impassable much of the time. The low income of most families permitted no means of transportation other than horses and mules, which were used in cultivation of their farms.

At the time of this report, only 66 of the known 331 living patients in the study had moved out of the county. More than half of these were concentrated in the three northern cities of Chicago, Cleveland, and Detroit. Many of these men return to the county for vacations and family visits; probably some eventually will return to end their days at their old rural homesteads. It is worth noting that the average age of the mobile group that has been traced clearly is younger (49 years) than the average age of the stable Macon County group (61 years). No significance can be attached to the fact that a larger number of syphilitic patients have moved out of the county (44 syphilitic patients versus 22 nonsyphilitic controls) because this reflects the original ratio of the study. In general, we feel that the stability of this group for a long-range medical study has been remarkable.

### Medical Facilities

In 1932, there were 1 Negro and 9 white physicians in private practice in Macon County. These physicians were fairly well distributed over the central and northeastern portions of the county, where the concentration of white population was greatest. None of the physicians was readily accessible to the Negroes concentrated in the southern and southwestern sections of the county. There were 4 dentists practicing in Tuskegee, the county seat.

The John A. Andrew Memorial Hospital, an outgrowth of the student infirmary, was established on the campus of Tuskegee Institute in 1912. This hospital offers excellent medical care for the Negro population of the county, but the poorer rural Negro cannot readily afford such care. On the outskirts of Tuskegee is located a Veterans Administration Hospital for Negroes (2,300 beds) which is staffed entirely by members of that race. This facility, however, does not supply medical care for the nonveteran population.

The Macon County Health Department was organized in 1928. Since 1930, numerous projects have been carried on in the county through this agency under the auspices of the United States Public Health Service, the Julius

Rosenwald Fund, and the Alabama State Health Department. Financial assistance from the Rosenwald Fund and the Public Health Service has been helpful in expanding the maternal and child health and venereal disease control programs.

In general, it can be said of Macon County that, through the efforts of medical and public health workers in the county over the years (*13*), the same progress has been made in the control of malaria, malnutrition, typhoid fever, the dysenteries, and other parasitic and infectious diseases as has been made throughout the rural south. In this study, such public health progress would be reflected in greater longevity of both syphilitic patients and control groups. This fact is important when the results of this investigation are compared with the higher mortality figures of older studies in the medical literature.

On the other hand, medical progress has not been so great nor medical care so widespread among our patients in Macon County as to defeat the project as a study of untreated syphilis. Despite the present prevalent use of antibiotics, with their known antisyphilitic potency, the study group remains essentially untreated: After careful interviewing, it was found that 34 of 133 patients with syphilis had received injections or oral medication which might possibly have been penicillin; 11 of the 34 received more than five injections.

### Socioeconomic Data

The assumption has been made, by inference, in all previous medical reports on this study (*1–9*) that the socioeconomic and health factors were so uniform in Macon County that mortality or morbidity rate difference between the control and syphilitic groups could be attributed solely to syphilis.

The importance of socioeconomic factors in the prevalence of venereal disease is well known, and the fact that lower income groups suffer from more frequent and more recurrent venereal infections has been well documented in the recent studies by Warner and associates (*14*) in Studytown, and by Bowdoin and coworkers (*15*) in Savannah, Ga. These studies would lead us to suspect that syphilitic patients, in general, fall into a lower socioeconomic stratum of society than a similar, nonsyphilitic group. Also, it is well known that there are other diseases and health hazards which are more prevalent among the lower economic classes, namely, malnutrition, tuberculosis, poor hygiene, and crowded living conditions. In any comparative study of syphilitic and nonsyphilitic subjects, it would be expected, unless proved otherwise, that the nonsyphilitic group would possess certain significant health advantages over their colleagues besides being free from syphilis. The question arises, how much mortality and disability in the study patients can be attributed to syphilis alone, to syphilis primarily, or to syphilis incidentally? Therefore, by interviewing each patient during the recent survey, socioeconomic information was sought for the first time in this study to determine if the nonsyphilitic subjects had any advantages, other than freedom from syphilis, which would predispose them to longer, healthier lives.

During the annual survey of 1951–52, efforts were made to locate and examine as many of the men in the study as possible. Physical examinations were performed on 232 individuals in the study group in Tuskegee and, of this number, 220 (94.8 percent) were interviewed regarding socioeconomic status. The composition of the study population furnishing information on this phase of the study is presented in table 3.

**Table 3. Results of the 1951–52 Tuskegee investigations (as of November 19, 1952)**

| Study population | Total | Syphilitic subjects | Nonsyphilitic subjects |
|---|---|---|---|
| Present composition of the study groups | 600 | 408 | 192 |
| Patients examined in Tuskegee [1] | 232 | 139 | 93 |
| Patients who refused examination | 9 | 6 | 3 |
| Patients interviewed for socioeconomic data [2] | 220 | 133 | 87 |

[1] Socioeconomic data obtained from 43 patients who had moved out of the county were omitted from this report.

[2] Note that almost entire group of patients examined (94.8 percent) furnished socioeconomic data. The 12 patients were not included because of such factors as low I. Q., deafness, or poor cooperation.

**Table 4. Socioeconomic data obtained from interviews: comparison of family status of syphilitic and nonsyphilitic subjects**

| Family status | Syphilitic subjects | Nonsyphilitic subjects |
|---|---|---|
| Total number of patients interviewed | 133 | 87 |
| Median age (years) | 61 | 60 |
| Marital status (percent): | | |
| Married | 80. 5 | 83. 9 |
| Separated | 9. 0 | 6. 9 |
| Widowed | 9. 8 | 5. 8 |
| Single | . 7 | 3. 4 |
| Number of children: | | |
| Living, total | 453 | 384 |
| Dead, total | 237 | 164 |
| Average number of children per patient | 5. 2 | 6. 3 |

*Family Status*

It will be noted from the comparative data contained in table 4 that the syphilitic and nonsyphilitic groups interviewed are quite similar according to family status. No appreciable difference could be shown in the marital status of the two groups; in the syphilitic group, 80.5 percent of those interviewed were married, 18.8 percent either widowed or separated, and 0.7 percent single, as compared to 83.9 percent married, 12.7 percent widowed or separated, and 3.4 percent single among the nonsyphilitic subjects. The median age of those in the syphilitic group was 61 years as compared to 60 years for those in the nonsyphilitic group.

*Community Activities*

Participation in community activities was determined by church or lodge membership. The church remains the center of social functions in the rural Negro community. Lodges are popular in Macon County in that they offer social attractions for their members, with monthly meetings and occasional special services at the church. A member in good standing pays dues and receives certain financial benefits in case of illness or death. The material presented in table 5 indicates that according to the above criteria the persons included in this study form a homogeneous social group. Approximately one-fourth of both the syphilitic and nonsyphilitic groups had no formal education; 61.7 percent of the syphilitic group and 52.8 percent of the nonsyphilitic group had 1 to 6 years of schooling, whereas 14.3 percent of the syphilitic and 18.4 percent of the nonsyphilitic groups completed 7 to 12 years. One member of each group completed 4 years of college training. Slightly more than 90 percent of each group reported regular church attendance and more than half of each group acknowledged lodge membership. In no instance could statistical significance be demonstrated in the measures of social status of the two study groups.

Work status, because it can be used as a composite measure of economic level and working ability, probably is one of the most satisfactory methods of comparing groups of persons in a study of this kind. It was found (table 6) that more than 80 percent of each group named farming as their occupation. In both groups 40 hours represented the median length of time worked per week. The fact that approximately one-fifth of each group were listed as retired or unemployed is not surprising when the advanced age of many of the study patients is taken into consideration.

Personal visits to the homes of the majority of the patients has led us to the observation that the homes of the controls do not differ materially from those of the syphilitic patients. Almost without exception the houses are sorely in need of repair, unscreened, and without modern conveniences. According to the 1940 census report, there were 5,205 farm dwelling units in

**Table 5. Socioeconomic data obtained from interviews: comparison of education and of church and lodge affiliations of syphilitic and nonsyphilitic subjects**

| Education and church and lodge affiliations | Syphilitic subjects | Nonsyphilitic subjects |
|---|---|---|
| Total number of patients interviewed | 133 | 87 |
| Education (percent): | | |
| No formal education | 23. 3 | 27. 6 |
| Grades 1–6 | 61. 7 | 52. 9 |
| Grades 7–12 | 14. 3 | 18. 4 |
| College graduate | . 7 | 1. 1 |
| Church affiliation (percent): | | |
| Regular attendance | 91. 0 | 92. 0 |
| Official church position | 6. 0 | 6. 9 |
| Nonmember | 9. 0 | 8. 0 |
| Member of lodge (percent) | 56. 4 | 66. 7 |

**Table 6. Socioeconomic data obtained from interviews: comparison of occupations and work status of syphilitic and nonsyphilitic subjects**

| Occupation and work status | Syphilitic subjects | Nonsyphilitic subjects |
|---|---|---|
| Total number of patients interviewed | 133 | 87 |
| Occupation (percent): | | |
| Farmers (including retired farmers) | 83. 5 | 86. 2 |
| Other | 16. 5 | 13. 8 |
| Work status: | | |
| Median hours worked per week | 40 | 40 |
| Retired or unemployed (percent) | 18. 8 | 21. 8 |

Macon County and, of this number, 4,500 were in need of major repairs, had no running water, no electricity, and no toilet inside the structure.

### *Economic Standing*

During the interviewing, questions regarding actual income were avoided because it was found that, in the hope of receiving financial aid, the patients often reported a much lower income than they actually received. Attempts were made to determine economic standing by questions pertaining to physical assets, such as acres of land and head of livestock owned. Since this method of questioning would be productive only among those actively engaged in farming, the comparisons in table 7 are limited to such persons, representing about two-thirds of the total questioned in each group. One-third of the farmers in each group owned their farms, the remainder either renting or sharecropping. Medians computed for acreage cultivation and livestock ownership showed that in both groups, syphilitic and nonsyphilitic, farmers cultivated about 30 acres of land and owned 1 or 2 mules and cows. The median farm hours worked per week was identical with the median hours worked by the entire groups.

## Diet

Because of medical interest in the significance of diet in health and disease, attention was focused on the dietary habits and body weights of the men. Weight, height, and body habits were recorded. In comparing the syphilitic patient with the nonsyphilitic subject on weight basis alone, it can be seen from table 8 that those in the nonsyphilitic group tend to weigh more than those in the syphilitic group. Due to the numbers of persons compared, that is, 126 syphilitic patients versus 84 nonsyphilitic, the small differences are not significant. In comparing these Alabama farmers with the general population for relative incidence of obesity, the tables prepared by the Metropolitan Life Insurance Company (*16*) have been used. Apparently obesity was less prevalent in the study patients than in the general population; the physiques usually seen after these men undressed for examination were lean and hard-muscled.

The clinical impression regarding obesity is supported when the prevalence of excess weight in males in comparable age groups is compared, as follows:

| | *Age group (years)* | *Obese (10 percent or more above ideal weight) (percent)* |
|---|---|---|
| General population (10,000 unselected insurance examinees) | 40–60 | 35 |
| 210 Negro male patients | 45 and over | 21 |

Dietary histories were taken at random among the patients, and no remarkable differences were observed. During the period when the examinations were being done, these men were relatively inactive on the farms, and were

**Table 7. Comparison of data on physical assets obtained from farmers among syphilitic and nonsyphilitic subjects**

| Physical assets | Syphilitic subjects | | Nonsyphilitic subjects | |
|---|---|---|---|---|
| | *Number* | *Percent* | *Number* | *Percent* |
| Total number of patients interviewed | 133 | ------ | 87 | ------ |
| Number actively engaged in farming: | | | | |
| Own farm | 30 | 34. 1 | 22 | 37. 3 |
| Rent farm | 50 | 56. 8 | 35 | 59. 3 |
| Sharecrop | 8 | 9. 1 | 2 | 3. 4 |
| Median acreage cultivation per farmer | 30 | ------ | 32 | ------ |
| Median livestock ownership per farmer: | | | | |
| Mules | 1 | ------ | 2 | ------ |
| Cows | 2 | ------ | 2 | ------ |
| Median hours worked per week | 40 | ------ | 40 | ------ |

**Table 8. Prevalence of body weight [1] abnormalities among syphilitic and nonsyphilitic subjects**

| Weight status | Total | | Syphilitic | | Nonsyphilitic | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| Underweight | 61 | 29. 1 | 40 | 31. 8 | 21 | 25. 0 |
| Obesity [2] | 45 | 21. 4 | 25 | 19. 8 | 20 | 23. 8 |
| Normal [3] | 104 | 49. 5 | 61 | 48. 4 | 43 | 51. 2 |
| Total patients | 210 | 100. 0 | 126 | 100. 0 | 84 | 100. 0 |

[1] Standards used in determining weight abnormalities were those prepared by the Metropolitan Life Insurance Company (*16*).
[2] 10 percent or more above ideal weight.
[3] Including patients less than 10 percent above ideal weight.

eating two meals a day, one at midmorning and the other late in the afternoon. The main foods were fresh pork (usually eaten at both meals), cornbread, biscuits, collards, mustard greens, milk, and syrup. Heavy seasoning with salt, hot sauce (green and red peppers in vinegar), and mustard was the general rule. The same foods appeared with monotonous repetition. By observing the foods freely selected by the patients at the hospital cafeteria on the day of examination, it was apparent that these men like relatively few dishes. As a rule, they were interested only in meat (pork or chicken, never beef) and bread, and would select vegetables only upon the suggestion that they do so.

## Age

One of the problems which has caused concern in this study is that of uncertain reckoning of ages by these men. Inconsistent ages are given not only at each of the surveys, but, in some cases, on the same day to different interviewers. Experience gained in this study confirmed that of the sociologists who worked in Macon County in 1932 and reported in Shadow of the Plantation (*12*): "One of the difficulties encountered in dealing with this older population is the confusion about ages. The most common method of keeping reasonably accurate ages is through their 'white folks,' who made and kept this record for the Negroes. Those who lacked the continuing relationship with a single white family would have them set down the most likely age or date of birth in a Bible. If the 'white folks' died, or the Bible was lost, their ages were also lost and this was counted as irrevocable, not to be troubled about further. After all, ages are needed only at rare intervals, when a census is taken or for the even less exacting requirements of an obituary and death certificate."

However, despite the nonchalant attitude of the patients toward calendars and time-reckoners, it cannot be denied that they are 20 years older today than they were at the onset of the study.

## Summary and Conclusions

Much progress has taken place in Macon County since this study began in 1932, but the economic standing and cultural isolation of most of the rural Negroes in this study have not changed remarkably. These farmers still live in the same shacks that they occupied 20 years ago, and still eke out an existence by the same crude methods of farming. The younger generation is different in that its members tend to migrate to higher wage-scale industrial centers.

For the men in this study medical care has not improved appreciably in the past 20 years. The men still rely on home remedies and old superstitions to cure their ills. Excellent medical facilities exist within the county, but either the cost makes such care prohibitive to this low-income group or the patients are unaware of their availability.

In this study, as evidenced by the interview data presented, the socioeconomic differences between persons having syphilis and persons who do not are slight; the advantageous dif-

ferences, when any can be found at all, are slightly in favor of the nonsyphilitic group. In the men studied, isolation and cultural and economic retardation have been so uniform that the outstanding differences between the group with untreated syphilis and the nonsyphilitic group is still the medical fact that some have syphilis and some have not.

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## PHS Staff Announcements

**Dr. Donald W. Patrick,** medical officer in charge of the Public Health Service Hospital in Baltimore since 1949, will succeed **Dr. John A. Trautman** as director of the Clinical Center of the National Institutes of Health, Public Health Service, Bethesda, Md. In addition to other medical and administrative assignments, including the direction of the Service's hospital in Detroit prior to 1949, Dr. Patrick participated in various research activities of the Service from 1936 to 1940, working on typhus and spotted fever problems in research laboratories in the District of Columbia and conducting clinical research in leprosy at Kalihi Hospital, Honolulu.

Dr. Trautman will assume charge of the Public Health Service Hospital in Fort Worth, Tex., a 1,000-bed institution devoted mainly to treatment and study of psychiatric disorders and narcotics addiction. He has been in charge of the Clinical Center since 1951—it was under his direction that the patient care staff of the new research facility was assembled and the first study patients were admitted in July 1953.

# Reports on Physician And Nurse Manpower Problems

The Ninth National Conference on Rural Health, sponsored by the American Medical Association's Council on Rural Health, was held at Dallas, Tex., on March 4–6, 1954. Two of the conference papers, presented in condensed form below, offer solutions to the problem of physician distribution and the problem of nurse recruitment.

## A Program for Improving Physician Distribution

PHR brief

Distribution of physicians is a particular problem in Texas because of the vast size of the State and the sparse population in many areas. There are certain areas in Texas, as elsewhere in the Nation, where a physician cannot live and earn a living, but there are many areas where a better distribution of physicians can and must be provided.

In May 1952, the House of Delegates of the Texas Medical Association authorized the formation of the Committee on Doctor Distribution to determine the exact conditions concerning distribution of physicians and to work with those communities that have been unable to secure or keep a physician.

*By Chester U. Callan, M.D., chairman of the Rural Health Committee and chairman of the Committee on Doctor Distribution, Texas Medical Association, Rotan, Tex.*

### Physician and Community Surveys

The committee's first step was to ask the physicians themselves what they thought conditions were. Questionnaires were mailed to approximately 6,500 physicians, and replies were received from about 6,000. They provided information concerning the ratio of physicians to population, type of practice, percentage of time spent in practice, number of miles traveled in making house calls, number of patients seen daily, and hospital facilities available. Each physician was asked if he believed his community needed more physicians, and if so, whether the community would support them.

The next step was to contact the communities. The committee is now in the process of writing directly to the secretaries of the chambers of commerce, the mayors, or the county judges and asking them for their opinion as to whether or not additional physicians are needed. They are advised that, unless they respond, the committee will assume their needs are being met adequately. They are informed also that if they feel a shortage of physicians exists, the Texas Medical Association will send a competent representative to visit the community.

Before a community is contacted, each physician in the area and the officers of the county medical society are informed of exactly what the association is doing. In this way, their cooperation and support is obtained.

### Committee Assistance

To help the community determine whether or not a shortage of physicians actually exists and also to emphasize that securing and keeping a physician is the joint responsibility of the medical profession and the community, the committee has prepared a booklet posing such questions

as these: Will the community actually support a physician or will it bypass him when serious illness arises and send its patients to the nearest large city? Are office facilities available? Is prescription service accessible? What hospital or clinical facilities exist? What housing facilities are available? What types of schools and churches does the community have? The booklet suggests that the community appoint a committee to answer these questions and, if necessary, to send a letter requesting assistance in securing additional physicians to the Texas Medical Association's physicians' placement bureau. The booklet is sent with the initial communication to the community.

At present, the committee is planning to send into the communities indicating a shortage of physicians, an association official to work with local officials in analyzing the extent of the need. Recently employed, this official will start to work in the near future. With guidance of the American Medical Association, the committee has prepared a questionnaire which it believes will clearly show whether or not the community can and will support an additional physician or physicians.

#### Coordinated Activities

The program of the Committee on Doctor Distribution supplements, and in no way replaces, the work of the Texas Medical Association's physicians' placement service. Once a community clearly demonstrates its need for a physician, it is the job of the placement service to get one there as soon as possible. During 1953, this service placed 38 general practitioners in rural communities in Texas. At present, 34 communities are listed with this office as needing additional physicians, and 60 general practitioners are listed as seeking locations. An additional 64 general practitioners are listed as available in the coming months.

The Texas Medical Association is also working to create a reservoir of physicians for tomorrow. The University of Texas Medical Branch, in cooperation with the association and the Texas Academy of General Practice, has an active preceptorship program. Under this program, each senior medical student must apprentice himself for 11 weeks to an approved preceptor before he can graduate. He lives and works in private practice with his "father in medicine." Since the beginning of this program in July 1952, there has already been a sharp increase in the number of senior students indicating that they desire to practice in rural areas.

# Girls' Club Interest In Hospital Fields

PHR brief

Attractive high school girls consuming cookies by the dozen but performing a community service and, perhaps more important, learning about professions in which there is an ever-increasing need in this country for personnel are the JUG's of Akron, Colo. The JUG's, which stands for Just Us Girls, is a club for high school girls which was organized in 1950 to interest them in nursing and allied fields.

The need for such a program in Akron became apparent when plans were made for building a new 22-bed county hospital and the problem of obtaining staff was encountered. Considering the problem a long-range one, the Washington County (Colo.) Public Hospital decided that an attempt to interest girls in the community in the hospital fields was a logical approach. We realized that the more girls recruited for training from the community, the more chances the hospital would have of obtaining the necessary professional staff.

The idea of a club which would provide an opportunity for high school girls to become familiar with the hospital fields by actually working in them was advanced as one possible means of stimulating interest. The idea was discussed with the principal and some of the

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*By Esther Thornton, R.N., superintendent of Washington County Public Hospital, Akron, Colo.*

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teachers of the local high school, and the school officials agreed to cooperate and support such a project. They recognized that hospital work could well be considered one of the chief vocations for young girls in this rural area.

Clubs for teen-agers interested in nursing, of course, are not new. The Future Nurses Clubs, for example, which were pioneered in Michigan, are well established, especially in the eastern States. The Candy Strippers of East Orange, N. J., are a very progressive group of junior high school girls. Apparently, however, little effort has been put forth in developing such clubs in rural areas, where, with the increasing number of hospitals, the need is just as great, if not greater, than in urban areas.

### Organization and Activities

As soon as school support for the project was obtained, a questionnaire was given to each of the 80 girls in the high school. Fifty of them indicated that they were interested, and designated the particular hospital work in which they would like to participate. The hospital auxiliary of Washington County, in which Akron is located, accepted the challenge of sponsoring the club, and three persons were selected as individual leaders: the hospital superintendent, a member of the hospital auxiliary, and a member of the school faculty chosen by the girls.

The club was organized and ready to function by the time the move to the new hospital was made.

There are five different types of activities from which the JUG's may choose: They may serve as regular nurses' aides, or patients' aides as we prefer to call them, who perform such duties as arranging flowers, passing food trays, taking temperatures, and making beds. Recently, members of this group have been assigned to travel with the county public health nurse on her visits to schools, clinics, and classes for mothers. The nurses' aide group is the one in which most girls are interested. Girls who are interested in dietetics or home economics may help in the kitchen, preparing food and trays for patients. Another group works in the laboratory and X-ray room, filing cards and simply observing; they may someday be interested in becoming medical technologists. Girls who like office work man the hospital's front desk, where they type, file, answer the phone, and direct visitors. Still others assist with occupational therapy, teaching the patients arts and crafts.

At the beginning of the school term, each patients' aide is given 10 hours of class instruction. Then she is ready to wear a uniform and to go to work on the floor at the hospital. After 100 hours of volunteer service, a JUG is entitled to an award pin, available through the American Hospital Association, and, after learning some 30 special procedures, she is eligible to wear a cap. The JUG's in the other service groups are given no formal training. They learn on the job, through experience. They also wear a uniform and receive an award pin, but no cap is awarded. A JUG may receive pay after she has finished 100 hours of volunteer service, but most JUG's donate their services.

### The Club's Progress

The club in 1954 has 35 members. Interest in the organization is expressed even by kindergarten pupils, whose ambition is to "grow up and be a JUG." To recruit new members and thus keep the club active, a JUG visits the eighth grade class each year shortly before school is out and describes its program, and each year some 20 new members are pledged.

Admittedly, most of the girls enter the club not because they are especially interested in hospital work but because it is the thing to do. But they can be expected to leave with sufficient understanding of the work to know whether or not nursing, dietetics, medical technology, or occupational therapy is a profession in which they would like to seek a career.

Some of the JUG's have continued with their interest in nurses' training: 8 girls have gone into schools of nursing; 1 girl is studying to be a medical librarian; 1 girl is attending a laboratory and X-ray technician training school; and 6 girls are doing medical secretarial work.

# Self-Understanding For the Parents Of Handicapped Children

By JULIUS B. RICHMOND, M.D.

THE PARENTS of all children—handicapped or normal—are interested in helping children grow into mature, self-reliant persons who have the capacity to contribute to, as well as to take from, the community in which they live. The success with which this objective is attained is to a considerable extent a reflection of the understanding which parents have not only of their children, but also themselves. For if parents do not understand themselves, they may, by superimposing emotional complications, increase the difficulties of children already subjected to a handicapping condition. This may minimize the child's effectiveness in dealing with his problems. Therefore, by increasing self-understanding of parents as individuals we in turn increase self-understanding among children with the result that better adaptation to the handicapping condition and to the community may be facilitated.

As parents grow in self-understanding, there are developed new and deeper insights into helping children to achieve their greatest potentialities. A parent may develop new skills with which to help the child, and also learn to provide realistically for many of the specific needs of the child. But perhaps most significantly a parent can begin to understand that he may be limiting the child too much and thereby thwarting growth, or he may make the child insecure by asking too much from him at another time. Parents may increase their understanding to the advantage of the child in various ways. These group themselves about the significance of physical care; the development of independence; and self-understanding by sharing.

*Dr. Richmond, chairman and professor, department of pediatrics, College of Medicine, State University of New York, Syracuse, N. Y., gave the lecture on which this paper is based before the National Society for Crippled Children and Adults, in Chicago, November 13, 1953. He is a member of the board of trustees, Child Welfare League of America, and is on the editorial board of Psychosomatic Medicine.*

### Significance of Physical Care

Parents of a handicapped child have basic concern about the full significance and extent of the child's handicap. This concern may be obvious; often it is subtle. Parents of a child with a deformity uneasily ask their physicians rather diffuse and evasive questions about the condition when they really want to have some reassurance about not having any responsibility for the causation of the handicap. Particularly in the early days of adjustment to the full impact of the handicap, self-understanding stems from the sharing of one's doubts and anxieties.

The importance of an adequate program of medical care and ancillary services in all communities in order that all parents may be assured realistically that they are receiving the best possible help with their problems cannot be emphasized strongly enough. Certainly the impetus given by organizations such as the National Society for Crippled Children and Adults toward the nationwide attainment of high standards for the care of handicapped children has been a source of comfort to many parents. The program of providing scholarships of various kinds has made it possible for many communities to provide increasingly better services to the handicapped. Out of the continuity of care provided by professionally qualified personnel and from the reduction of doubts and anxieties, there develops a more effective relationship with children.

Out of an adequate medical program in which

parents have invested energy—and often money—come feelings of security in relation to the management of the child and also the courage to face the future. These can come in no other way. To illustrate, when parents of a child with progressive muscular dystrophy come to a physician he may be often embarrassed by the gratitude extended to him as a physician who admittedly is powerless—as are all others—to interrupt the progress of the disease. Physicians can begin to understand that these expressions of gratitude have real meaning when they stop to realize that in these visits the parents have had an opportunity to share their anxieties with physicans who have the most information, that they have been able to ask questions which all parents want to ask, and perhaps most significantly—that they have received reassurance that everything possible has been done to help their child.

Parents have the further reassuring factor that medical science is constantly discovering and seeking new information through research. Although research isn't often translated into personal terms, the support of research by parents or groups of parents provides them with hope, without which it would be difficult to face the future. Resources and energy often are expended heavily in the direction of service to patients while research suffers. As a physician and investigator, I must call to your attention that research is a very personal investment of all. For when research dries up, hope for the future vanishes.

### Development of Independence

To help children grow to maturity they need to be permitted to exercise increasing responsibility as age increases. Perhaps one of the greatest problems for parents in the rearing of handicapped children is the achievement of a delicate balance of understanding needed to determine how much responsibility is appropriate for the age and condition of the child. Overprotection ceases to be protection and may retard progress. Unfortunately, no rule of thumb can be employed with success; each child has his unique problems and rate of development.

Growth does not occur unless it is provided with building blocks. We have defined certain building blocks for physical growth which have become well known in the form of proteins, carbohydrates, fats, vitamins, and minerals. The psychological development of the child also has building blocks. These are evidenced in the form of a sense of trust in him, respect for his individual differences, and stimulation to develop his greatest potentialities. This latter point could be defined as "accentuating the positive."

A sense of trust in the child develops from the security he feels in those about him. The understanding which parents manifest; the capacity for patience which parents need to await progress, slow though it may be; the pleasure which they share as progress develops—all contribute to the development of the child's sense of trust in his parents first, and subsequently in the world about him. For if parents cannot be understanding, accepting, and patient, their anxieties are communicated to the child and have added to his burden.

Parents of handicapped children encounter problems similar to those parents of normal children face in dealing with individual differences. That no two so-called "normal" children are alike is now appreciated. An understanding of the unique problem of each child, his developmental rate, the fact that he may undergo a spurt at one time just as physical growth occurs in spurts, are all helpful. There is no normal level to which children and parents need aspire. "Mass-production psychology" which would tend to lower our sights to a "lowest common denominator" represents an unwholesome trend which we hope has been reversed. In order to understand the child's individual patterns, parents must learn to temper preconceived notions of what they expect children to do. This sometimes requires help from professional personnel outside the home who may provide us with a much more objective view of our relationships.

Out of a deeper understanding of the individual differences among children, parents can help children to develop the unique capacities they possess. Rather than being predominantly concerned with what the child can't do, parents can emphasize what he *can* do. With this emphasis we return to the importance of hope. Hope for the future must be placed in

terms of positive achievement; it cannot be built on a psychology of defeat and despair. Emotions are contagious; a parent's feelings of defeat and despair are all too readily communicated to the child. The child cannot have high expectations when these are not shared by parents.

### Self-Understanding by Sharing

Perhaps the greatest opportunities for parents to improve self-understanding arises from the sharing of experiences. Discussions of experiences and problems with other parents of handicapped children provide an opportunity for increasing the depth of understanding of problems. Physician parents of handicapped children with much knowledge of the handicapping condition of the child have often related how much help and support they have received from other parents. As a matter of fact, all physicians can learn from parents if they will afford themselves the inexpensive luxury of being good listeners. There is much the professional can learn from ordinary, everyday incidents. In this connection the story related by a mother of a preschool deaf child at an institute for mothers is worth retelling. She had a large farm family. A considerable amount of washing and ironing had to be done each week. One day as she was about to start ironing one of the children proposed that they have a garden tea party. To this she acquiesced. Just as they were in the midst of having a delightful time, Mrs. Smith's mother dropped in. The mother noted the large ironing to be done and told the daughter that she could be using her time to better advantage. Mrs. Smith thought about it for a moment but replied that "the children would probably never remember whether the washing had been done that week, but they would never forget the tea party." The overtones and undertones of this story had great meaning for parents and professional staff alike.

A few words of caution are in order however. Occasionally, parents in their devotion to group activities may find an outlet for their problems at the expense of the child. The central focus of energies and activities of parents must be the child, lest the child feel that his care has been relegated to a secondary position. Unfortunately, no one can provide the energy and understanding of which natural parents are capable. Children should, therefore, not need to settle for care which is second best.

The healthy sharing of experiences, supplemented by the sharing with professionally qualified people as indicated earlier results in ever increasing depth of understanding by parents. Out of such understanding emerges a more comfortable relationship which helps the child to attain his fullest potentialities. Parents who provide such understanding achieve gratifications which cannot be duplicated.

## Applications for Grants in Cancer Research

Acting for the American Cancer Society, the National Research Council's Committee on Growth is accepting applications for grants-in-aid for cancer research in the United States. Applications received before October 1 will be considered during the winter, and grants recommended at that time become effective on July 1, 1955. Investigators now receiving support will be notified individually regarding their application for renewal.

The scope of the research program is broad and includes, in addition to clinical investigations on cancer, fundamental studies in the fields of cellular physiology, morphogenesis, genetics, virology, biochemistry, metabolism, nutrition, cytochemistry, physics, radiobiology, chemotherapy, endocrinology, and environmental cancer.

Application blanks and additional information may be obtained from the Executive Secretary, Committee on Growth, National Research Council, 2101 Constitution Avenue, NW., Washington 25, D. C. D. C.



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